MODERN PLASTICS

MARCH 1944

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DESIGN DATA ON PLASTICS

III. Choice of Materials

FROM THE DUREZ LABORATORIES

That a relationship exists between good design and selection of a molding compound, goes without saying. How important the relationship sometimes can be is illustrated by the much-talked

Temperature range from —40° F to +170° F

about trench mortar shell fuze, molded with a Durez phenolic.

Saving a sizeable weight of material on each fuze, Durez takes the place of machined aluminum. It was recognized from the first that certain changes in design would be required. Yet, the plastic parts had to be interchangeable with those of metal. This set up definite restrictions in design, of course.

Close tolerances have to be held. There must be a minimum of shrinkage coming out of the mold. But what everyone knew would be a difficult molding operation just had to be made to work. Those were "orders" from the war-front. It was a precision job from start to finish. Furthermore, design and material had to be correlated to service specifications. In temperatures from —40° F to + 170° F there must be absolute dimensional stability. Cold flow must be at a minimum. Moisture resistance is essential.

This shell fuze has been a challenging and highly-important plastic project. We are pleased to report the satisfactory performance of a Durez pheno ic. More than that, it is an excellent example of the teamwork which goes on within the Plastic Industry...among designers, molders and material producers.

Perhaps this same teamwork can be applied profitably to a design you are considering. The versatility of Durez phenolics gives you almost any combination of properties you seek. It may prove to be an important time-saver in your development work.

A precision job from start to finish

We welcome your inquiry and offer the facilities of one of the most experienced technical staffs in Plastics. Durez Plastics & Chemicals, Inc., 53 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC MOLDING COMPOUNDS AND RESINS

PLASTICS THAT FIT THE JOB

Tech

CATALIN
Tomorrow's radio must, to the eye as well as to the ear and hand, encompass and symbolize the tremendous advances now being made in transmission and reception techniques.
Of all radio housing materials, Catalin, the gem of plastics, possesses the qualities that will prove most essential to accelerated postwar radio manufacturing and merchandising.
Romanced here, and in the spirit of radio's bright opportunities, this interpretation of a design by Charles Leslie Fordyce is expressive of what Catalin promises . . . unmatched qualities of gem-like color and beauty!
Now is the time to pencil onto paper or prepare in visual form thoughts keyed to the anticipated desires of this forthcoming market.
The Catalin staff is ready to cooperate with manufacturers in all fields—on present and future plastic problems. Inquiries invited.
CATALIN CORPORATION
ONE PARK AVENUE • NEW YORK 16, N. Y.
CAST RESINS • MOLDING COMPOUNDS • LIQUID RESINS
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MODERN PLASTICS

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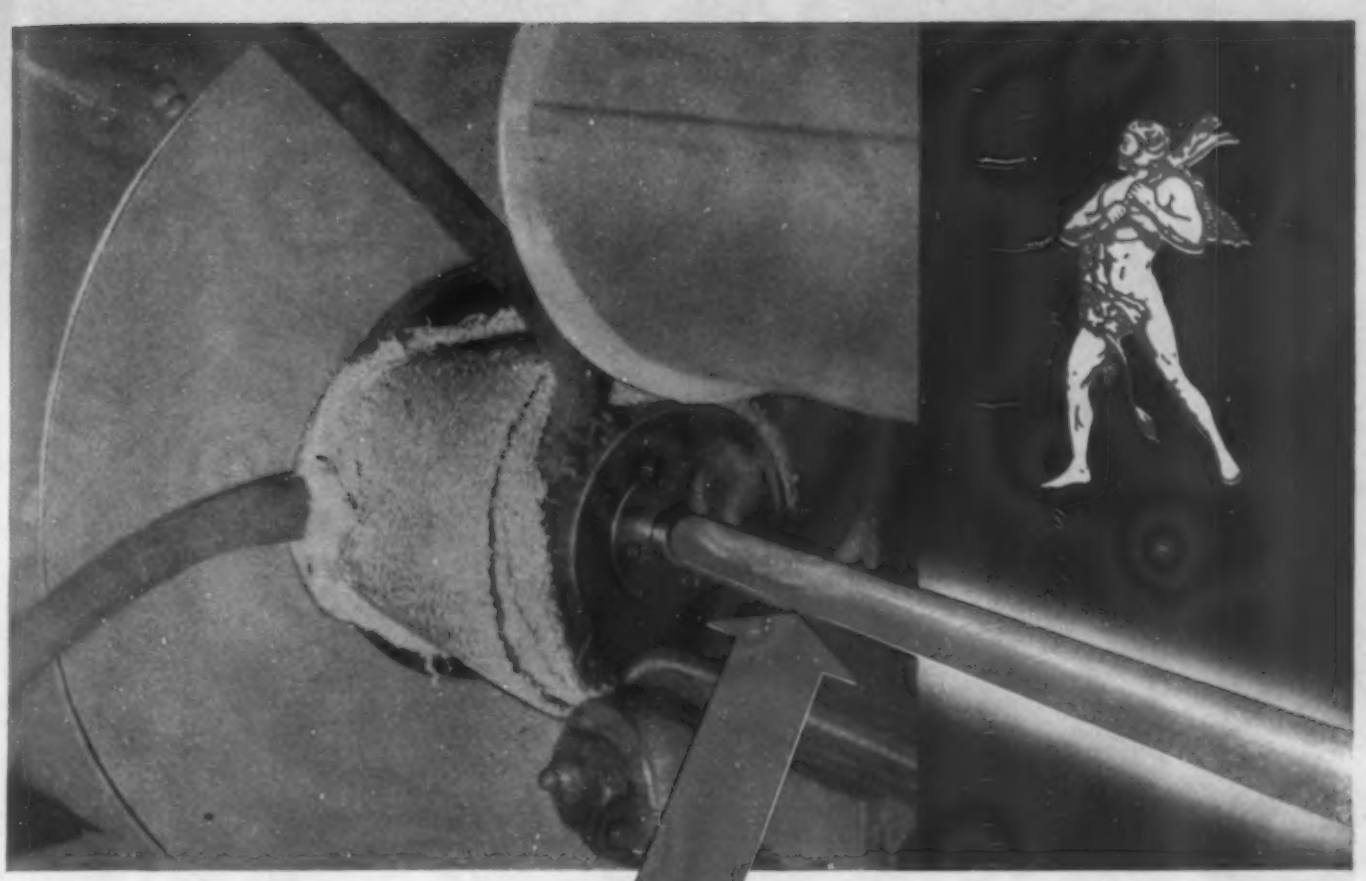

Here's where HERCULES GETS TOUGH...

And Durable . . . and Light . . . and Flexible . . . and Stable!

THE legendary might of Hercules is no legend today. Cellulose Acetate and Ethyl Cellulose for plastics, developed by Hercules Powder Company, can "take" all the punishment that modern gladiators give them.

The Navy's First Aid Kit, for instance, has to be feather-light, yet rugged as a heavyweight. Plastics based on Hercules Cellulose Acetate meet those requirements . . . in addition will not bullet-splinter, take a permanent finish.

The U. S. Army's new flashlights are made of plastics based on Hercules Ethyl Cellulose because these cases must withstand temperature changes from minus 40° F. to plus 180° F.—and always be on the job, ready for action, in dry weather or wet!

Cellulose Acetate and Ethyl Cellulose plastics may be extruded as rods, strips, sheet or tubing, film or filament, for an enormous variety of purposes . . . from heavy cable insulation to light, flexible tooth paste tubes.

The National Extruder helps Hercules plastic materials get tough, flexible, stable, lightweight, transparent—in the Hercules laboratories. It is indispensable in evaluating and improving raw materials and formulations, is also used by Hercules for developing extrusion technique on these plastics.

More than any other extruder, the NATIONAL has contributed to the development of great ideas in plastics.

ARMY (E) NAVY
CLIFTON DIVISION

Plastics Division

NATIONAL RUBBER MACHINERY COMPANY
GENERAL OFFICES: AKRON, OHIO

THAT REMINDS ME...

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HAS HIGH IMPACT STRENGTH

PRODUCT designers who are developing new products and improving existing ones, which require relatively high impact strength, are specifying INSUROK. It has the ability, extremely important in many products, to absorb shock and stand up under rough handling.

And in addition, the light weight and structural strength of Laminated INSUROK make it adaptable to a wide variety of products which must meet rigid mechanical specifications. Its resistance to the reaction of most chemicals and temperature changes has qualified INSUROK for many chemical applications.

There are many grades and types of Laminated and Molded INSUROK, one or more of which will meet practically every requirement. Richardson Plasticians, experienced in working with designers and manufacturers, will be glad to help you determine the grade best suited to your needs. Write for complete information.

Unless your product is going to be handled with "kid gloves"—it may be advisable to give it the advantage of INSUROK's high impact strength.

"Facts About Plastics" gives a full, non-technical description of plastics and their use. Every executive concerned with product development or marketing should have a copy. Write for one on your company letterhead today to Dept. C, Melrose Park, Ill.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

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More information on crystal-clear Du Pont "Lucite" methyl methacrylate resin sheets for aircraft designers, engineers, and suppliers of transparent enclosures

What is the THERMAL CONDUCTIVITY of "LUCITE"?

Du Pont "Lucite" methyl methacrylate resin transmits heat slowly (at about one-fourth the rate of glass, for example, and 1/800th the rate of aluminum)

The low thermal conductivity of Du Pont "Lucite" methyl methacrylate resin is evident with a simple touch of the hand; the feeling of *warmth* is the effect of *slow* dissipation of heat from the hand . . . a low rate of heat absorption by "Lucite," in contrast to the higher rate experienced in touching glass or the much higher rate in touching metals. The thermal conductivity of "Lucite" is about one-fourth that of glass, about the same as that of rubber, and 1/800th that of aluminum.

THERMAL CONDUCTIVITY

Du Pont "Lucite" in cast sheets	Glass	Aluminum	
1.5 to 2.0	5.0 to 7.0	1300 to 1500	BTUpersquarefoot per inch per degree F per hour
0.0005 to 0.0007	0.0017 to 0.0025	0.46 to 0.50	calories per square centimeter per centimeter per degree C per second

METHOD OF MEASURING THERMAL CONDUCTIVITY

The rate at which heat travels through cast "Lucite" is found by use of standard thermal conductivity apparatus. A copper block of known heat capacity is cooled to a few degrees below the temperature of the laboratory. Used as a heat source is a container of water kept at constant temperature. A test piece of "Lucite," with films of oil to obtain good thermal contact, is sandwiched between heat source and copper block. Thermocouples placed in the heat source and copper block show the rate at which block temperature rises. When the block reaches laboratory temperature, it is receiving heat only through the sample, and the rate of flow is readily determinable.

GLITTERING *under the lights of an assembly bay, this "Lucite" turret is about to go into a Martin PBM. Martin is one of many plane builders who select "Lucite" as a worthy component of their superior craft.*

WHY "LUCITE"?

"Lucite" is Du Pont's trade-mark for its methyl methacrylate resin, available in cast sheets, rods, tubes, large castings, molded sheets, and molding powders. Its standard color is clear transparent—over 90% light transmission. This feature—plus good characteristics of weather resistance, lightness, tensile and impact strength, satisfactory resistance to chemicals to which it is commonly exposed, as well as its ease of forming and fabrication—commends the use of "Lucite" in countless aircraft applications. "Lucite" meets U.S. Navy and Army Air Corps specifications P41C (Grade A) and 94-12014B, respectively.

The 114-page aircraft manual on "Lucite" gives detailed information on the general properties of "Lucite" as well as on its fabrication, forming, and repairing. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 So. Broadway, Los Angeles 3, Cal. In Canada, Canadian Industries, Ltd., Montreal.

DU PONT PLASTICS

DU PONT

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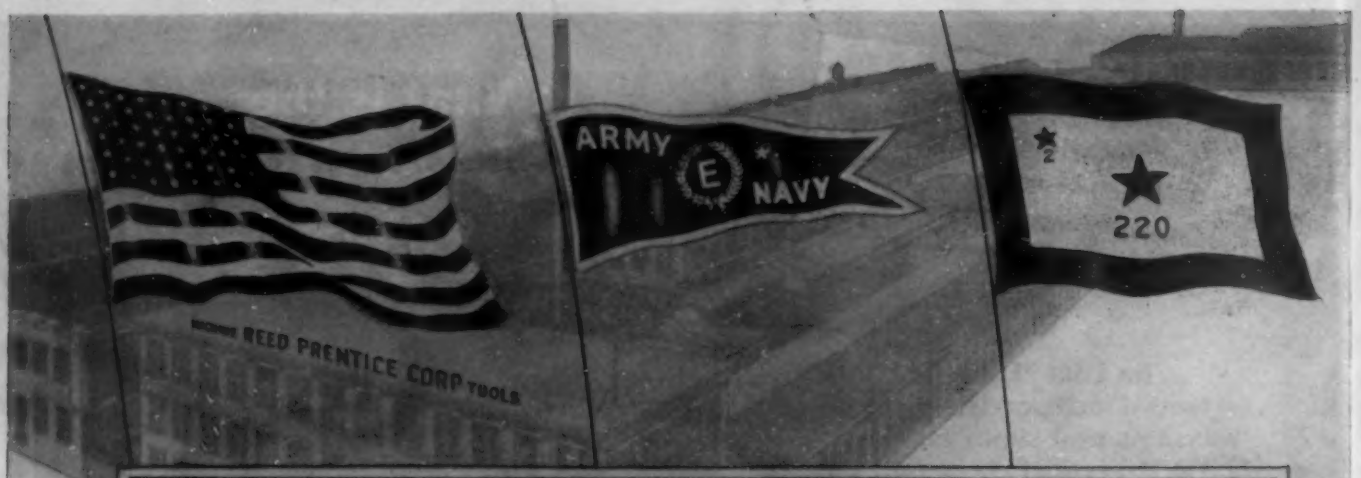


PLEDGE TO THE INDUSTRY

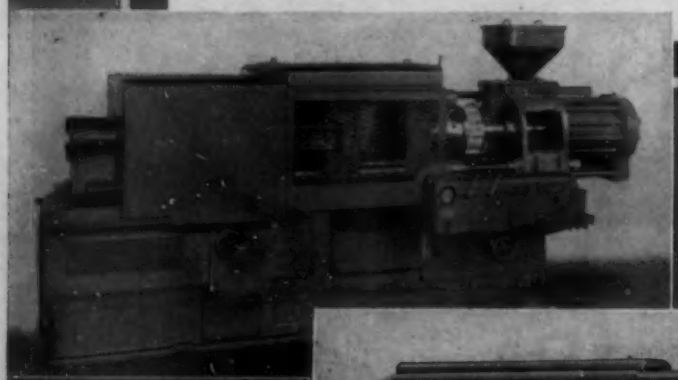
The REED-PRENTICE CORPORATION pledges to the Plastic Industry its continued research for the advancement of the industry in respect to development of injection molding machines.

In the injection molding field we promise further machine refinements and innovations which will result in increased profit possibilities for our present and future customers.

We pledge that we shall retain our high standards of accuracy, integrity of workmanship, and selection of the finest materials possible.

As in the past, new developments will be adaptable as far as possible to those machines in the field as well as those in the process of construction, in order that our customers may utilize the best in plastic injection machine construction with a minimum of outlay.

We pledge an even greater degree of cooperation with owners and prospective customers by the inauguration of a new engineering service for both machine selection and mold design and manufacture.



AT LEFT: 10-D Machine—capacity 6 oz. or 8 oz.
Also available 10-A machine—4 oz. capacity

BELOW: New 10-F Machine—22 oz. capacity

BRANCH OFFICES
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Cleveland, Ohio
75 West St.
New York City, N. Y.

REED-PRENTICE CORP.

MAIN OFFICE
WORCESTER
MASS. U. S. A.

Let's Talk About Plastic Housings

When housing problems arise, take a tip from the turtle. His plastic casing is a model of good design. Light in weight, it has toughness and strength in proportion to the protection it must give—and, large or small, the housing of the turtle always fits its tenant and his operations.

Burgess Vibro-tool with LUMARITH housing . . . shock-proof—comfortable to handle—50% lighter than metal.

For mechanical and electrical housings, such as control boxes, hand tools, shavers, radios, telephones, etc., it is logical to turn to plastics. Lumarith, in both cellulose-acetate and ethyl-cellulose formulae, brackets the full range of thermoplastic advantages. There is a Lumarith formula for every housing job. High impact strength, dielectric strength, moldability, toughness, dimensional stability at all temperatures, transparency, color and surface permanence can be obtained by specification. All Lumarith plastics are distinguished by their lack of brittleness.

It is likely that Lumarith is being used for housings of the type in which you are interested. You are cordially invited to call on our technical staff for factual assistance. Celanese Celluloid Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16.

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A CELANESE® PLASTIC
for Housings

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DOWN TO EARTH

Most plastics ads
picture pirouettes and pinwheels,
strange shapes asquint
in lozenges of light.
The artists use Modern Art,
they say,
because plastics are modern.
Are they?
Our experience with plastics
goes way back to 1840!
So our floor space
of thousands and thousands of feet
is firmly planted on the ground . . .
and we are looking for work
as molders in any plastic,
any process,
compression, injection, or jet.

HAVE YOU A PLASTICS PROBLEM?

Our Address is

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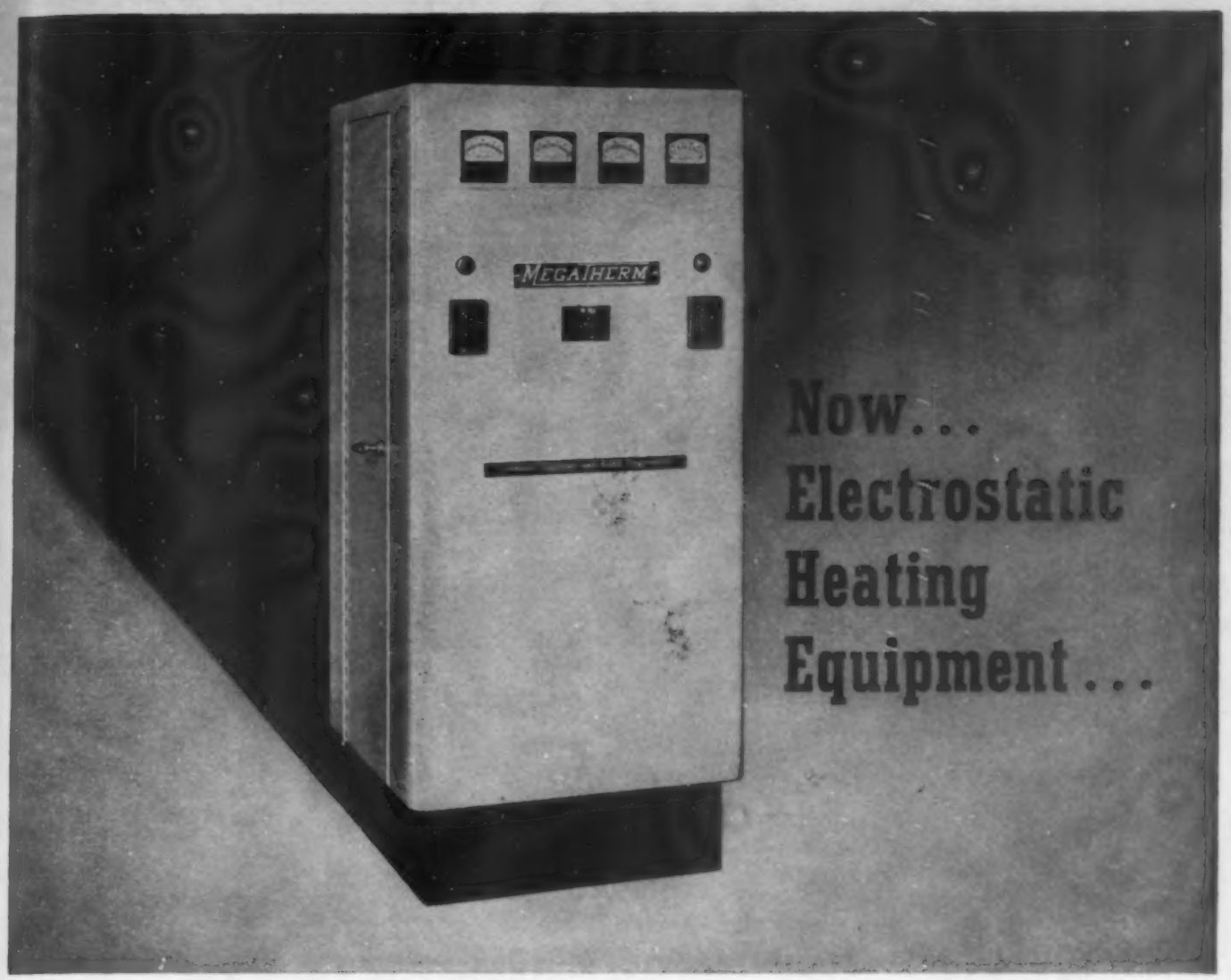
A DIVISION OF

Pro-phy-lac-tic Brush Co., FLORENCE, MASS.



...Designed and Built to the Special Requirements of the Plastics Industry

RUGGED
Stands Hard Usage; ⅛" Steel Cabinet

RELIABLE
Gives Efficient, Dependable Service

PORTABLE
Easily Moved for Any Application

COMPACT
All-in-one Unit Saves Floor Space

SIMPLE
Strictly Non-technical in Operation

SPEEDY
Increases Production

ECONOMICAL
Reduces Heating Time and Die Costs

SAFE
Complete Protection for Operator

In pioneering megacycle radio energy for industrial use, Federal has developed an application for Plastics processing that is unique both in conception and performance.

Through its Megatherm equipment it has put radio frequency heating on a practical basis, which assures perfect molding at low pressures, prevents breakage of die inserts, reduces curing time from minutes to seconds and provides uniformity, speed and economy.

Constructed along the same lines as any other machine tool, Megatherm equipment is installed without change in plant layout. It is ready for operation — merely has to be set alongside press and started to work for double or triple production. Simplicity of the unit eliminates tuning or other adjustment. It is controlled by two push buttons, with foot switch optional, and can be operated by unskilled, untrained help.

Megatherm will give you greater production at less cost.

We shall be glad to discuss it with you in terms of your requirements.

-MEGATHERM-

Federal Telephone and Radio Corporation

INDUSTRIAL ELECTRONICS PRODUCT DIVISION, Newark, New Jersey

AN IT&T ASSOCIATE

WHEN YOU CHOOSE YOUR PLASTIC MOLDER—

CONSIDER REPUTATION!

What has your custom molder done? How has he done it? What better yard-stick can he offer in evidence of his value to you?

Because you've *got* to live with Plastics to know them. There's no other way to pick up a thorough knowledge of all their characteristics from A to V (Acrylics, say, to Vinyls) . . . not only as applied to basic compounds, but to the infinite combinations of each group. Without this kind of experience, you're going to stumble somewhere along the line . . . in Molding, Mold-making or Engineering. Especially Engineering!

Here at Kurz-Kasch, we've learned Plastics the hard way and the right way—by working with them since the infancy of the Plastics Industry. Today, this generation of experience is concentrated here for your use at the Plastic Round Table. Customers new and old keep telling us that consulting us *as the first step* in their plastic plans gives infinitely better results.

And what else is a reputation based on?

DON'T DISREGARD post-war plans today! We may have our hands busy nowadays, but we've got one eye on the future. This is no time to be lying down on Engineering and, maybe, Mold-making. Ask for a Kurz-Kasch engineer!

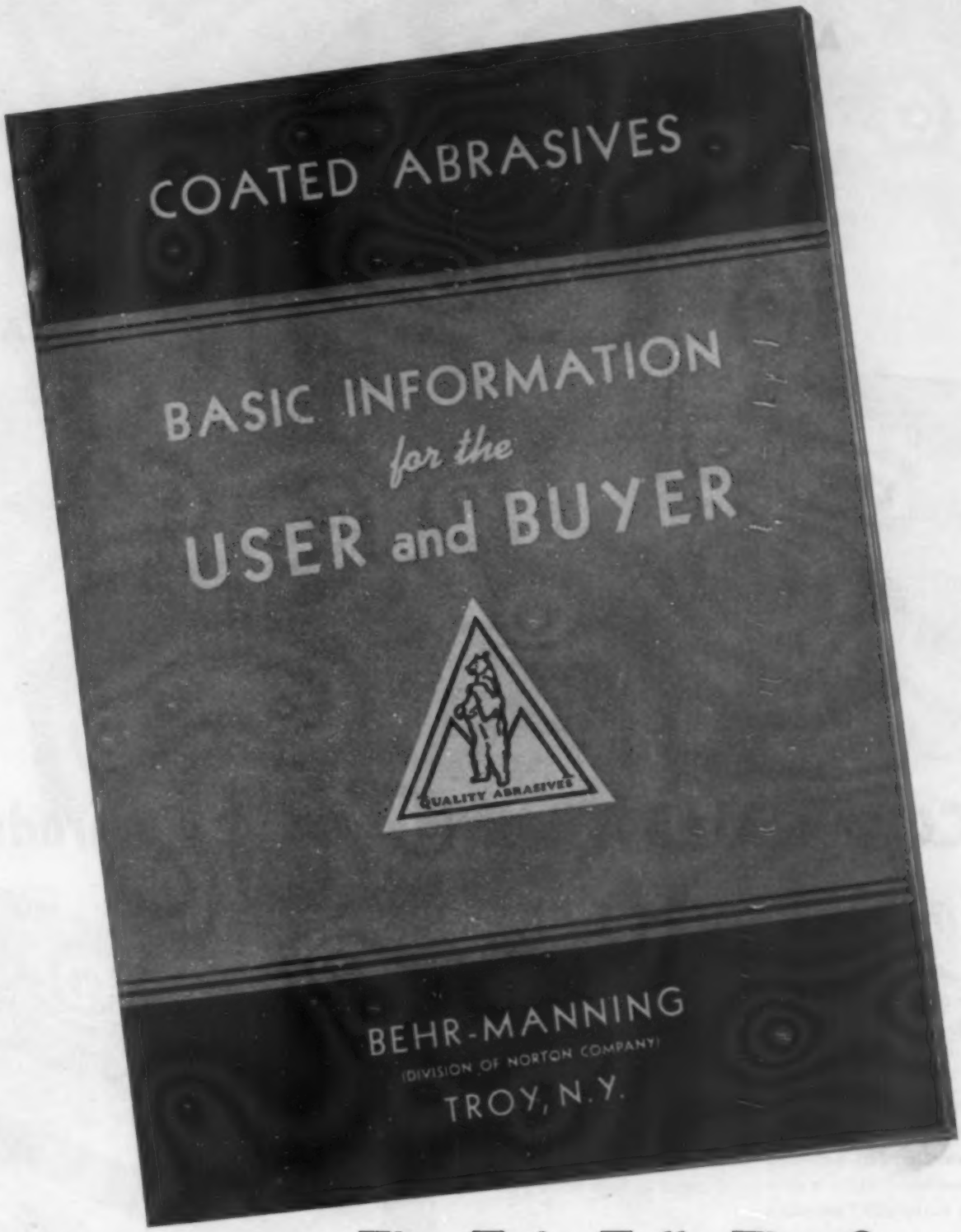
LET'S ALL WORK FOR VICTORY—WITH WAR BONDS!

KURZ-KASCH

For over 25 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1421 South Broadway, Dayton, Ohio

Branch Sales Offices: New York • Chicago • Detroit • Indianapolis • Los Angeles • Dallas St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City



The Title Tells The Story

Learn more about these modern, highly specialized cutting tools whose manufacture has been our sole occupation since 1872

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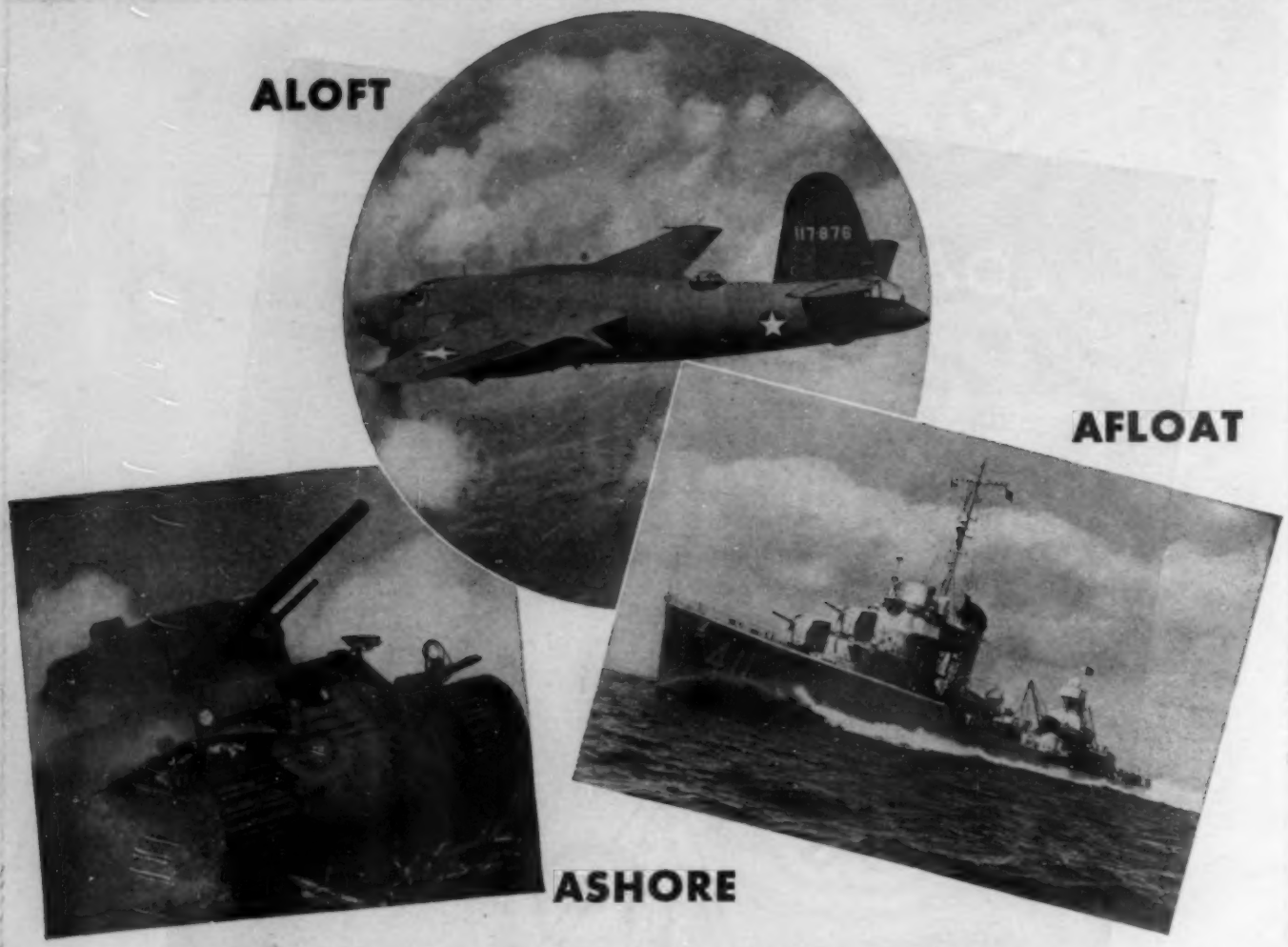
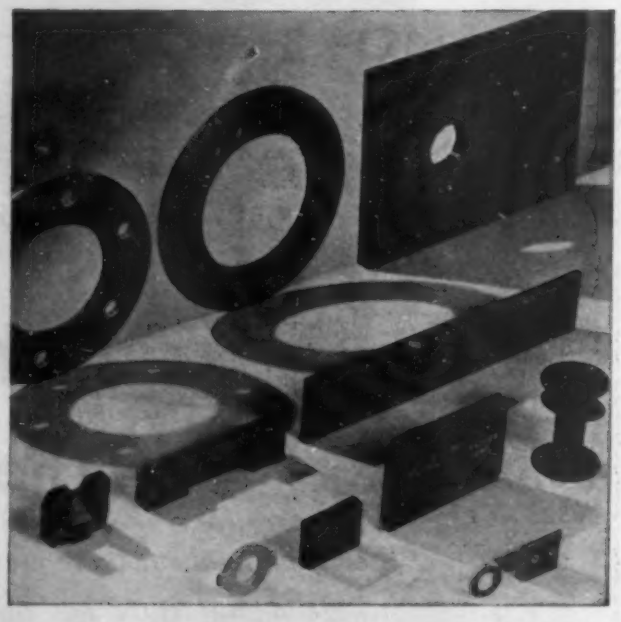


A CONTINENTAL DIAMOND *product*

is in there slugging!

C-D makes hundreds of electrical and mechanical parts which are vital to the successful operation of radios, guns, controls, communication systems, and all electrically energized units in our fighting equipment afloat, ashore and aloft.

Many of these applications posed new problems and conditions for NON-metallics. The research and experience which resulted has provided our laboratory with a wealth of "know how" which is at your disposal to help solve your "What Material?" problems.



C-D products include THE PLASTICS... DILECTO—a laminated phenolic: CELORON—a molded phenolic: DILECTENE—a pure resin plastic especially suited to U-H-F insulation... THE NON-METALLICS, DIAMOND Vulcanized Fibre: VULCOID—resin impregnated vulcanized fibre: and MICABOND—built-up mica insulation. Folder GP describes all these products and gives standard sizes and specifications.

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GP-48

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

The First Industrial High Frequency Dielectric Heating Equipment

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. . . it's heated with Thermex!

Thermex
A GIRDLER PRODUCT

PLASTICITY is practically perfect with Thermex high frequency heating. In achieving greater plasticity, this new kind of electronic heat produces many *related* advantages that are vital to the plastics industry. First, closing pressures are greatly reduced, so that mold breakage can be virtually eliminated. At the same time finish is improved . . . strength is increased . . . rejects become negligible. Thermex heating makes *larger* moldings practical, too. Thermex equipment is available in the most complete range of sizes *for* the plastics industry — in fully self-contained, portable units. For specific information, write us in detail about your problems.

THE GIRDLER CORPORATION, Thermex Division, Louisville, Ky.

MOLDS

that make plastic parts for the world's toughest customer

Uncle Sam's flying gun platforms are tough babies . . . they're designed right, then built to specifications which are as tough as they come. Good molds are the starting point for plastic parts that "measure up"... and Richard Brothers' Division of Allied Products Corporation, out of many years of producing quality dies for the metal working industry, knows how to make them good. Steam-heated *quality* molds for pilots' seats, bomber doors, aircraft flooring, navigators' drawers and other parts are but a few of the many fine Richard Brothers' Division jobs.

PILOT'S SEAT OF LAMINATED PLASTICS

The big steam-heated mold which formed this seat was produced by Richard Brothers' Division. The seat comes out of the mold in this finished state, with excess materials pinched off. Thus, trimming operations are eliminated.

BUY MORE WAR BONDS

"IT'S AN ALLIED PRODUCT!"... Richard-Brothers' Division of Allied Products Corporation also produces the famous R-B patented standardized Interchangeable Punch and Die used extensively in processing laminated plastics. Write today for the complete R-B catalog.

ALLIED PRODUCTS CORPORATION

Richard Brothers' Division • 1560 East Milwaukee
Detroit 11, Michigan

All four plants have now added a star to their Army-Navy "E" Pennants

MAKE 2 PRESSES DO THE WORK OF 3

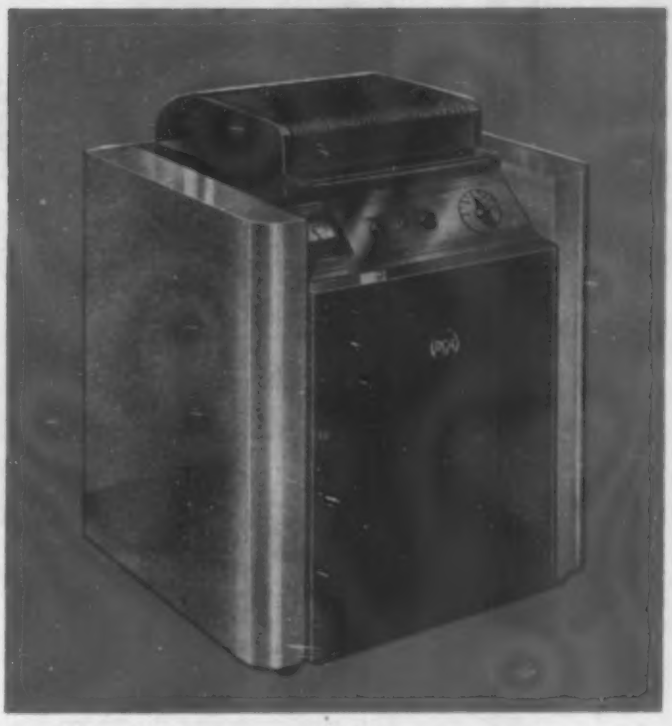
WITH THIS NEW RCA ELECTRONIC PREHEATER

HERE'S a new automatic electronic unit — the RCA Model 2-B —designed specially for the plastics industry to speed the preheating of preforms and increase press output.

Easy to Operate: The 2-B is as automatic as your toaster... just set the preform on a plate, close the protective cover, and press the START button. In a few seconds time, the preform is softened *all the way through*, the power goes off, and the cover opens.

Increased Press Output: Because electronic preheating provides *complete* softening, press closing is speeded up (in one typical case by 77%), curing time in the mold is cut down (in this case by 79%), mold stresses are greatly reduced, and product quality is improved both chemically and mechanically. As an average, *two presses will do the work of three!*

High Speed: The new RCA 2-B gives you not only the speed of electronic heat, but in addition, an ingenious electronic compensator that keeps the heating rate at a maximum in spite of chemical changes in the preform. The 2-B will heat one-pound of preformed material to 275°F. *all the way through* in 60 seconds.



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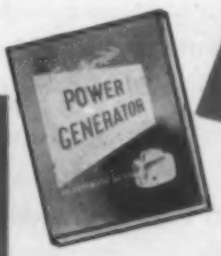
RCA

RCA ELECTRONIC HEAT

RADIO CORPORATION OF AMERICA



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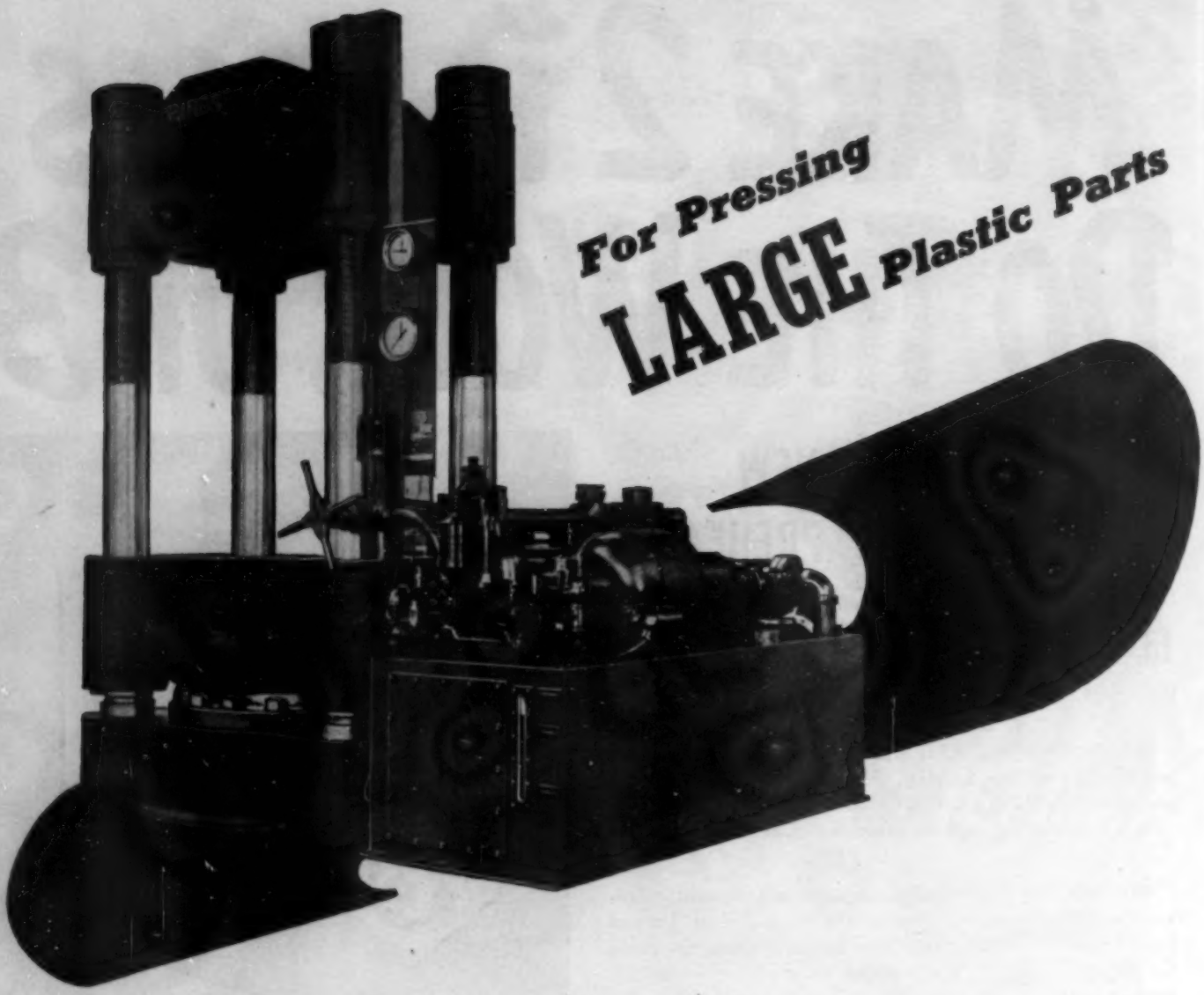


For Pressing LARGE Plastic Parts

This new up-acting Birdsboro Plastic Press, with *self-contained pump unit,* is designed for the pressing of *large* plastic parts . . . and is equipped with high and low pressure pump units for fast closing and economical pressing. Available in sizes such as 600, 900, 1200 tons and larger, this press incorporates all the latest improvement features found in other Birdsboro Plastic Presses.

Once again Birdsboro engineers turn their skill to building a press to meet a specific plastic industry need. Birdsboro specialists will be glad to discuss and help solve your individual press problems. Give them a call NOW!

Birdsboro Steel Foundry & Machine Co • Birdsboro, Pa.

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

PROBLEM: Valve Wheels
Plastic replacements of metal, 5" to 24" in diameter, with metal hub permanently incorporated. Must operate without failure under severe torque; must withstand corrosive and extreme temperature conditions.
SOLUTION: KYS-ITE
—the long fibred pulp and synthetic resin plastic pre-formed before curing.

There's something new—
KYS-ITE Valve Wheels.
Replacing metal predecessors
with this efficient-plus thermo-setting
plastic saves a ton of aluminum and a quarter ton of dead weight per Destroyer. KYS-ITE'S lustrous finish is impervious to salt sea spray, oil and grease and the many permanent colors quickly indicate use of different piping systems. Being non-conductive, these valve wheels are operated under extreme temperatures without burning or freezing bare hands.

Pre-war manufacture of electrical outlets and junction boxes, parts for refrigerators, business machines, radios and many domestic utensils utilized KYS-ITE'S impact strength (4 to 5 times greater than ordinary plastics), its dielectric strength, durability, light weight, abrasion resistance, lustrous finish and wide range of colors. These same qualities make KYS-ITE invaluable for present high priority war work applications.

KEYES
MOLDED PRODUCTS

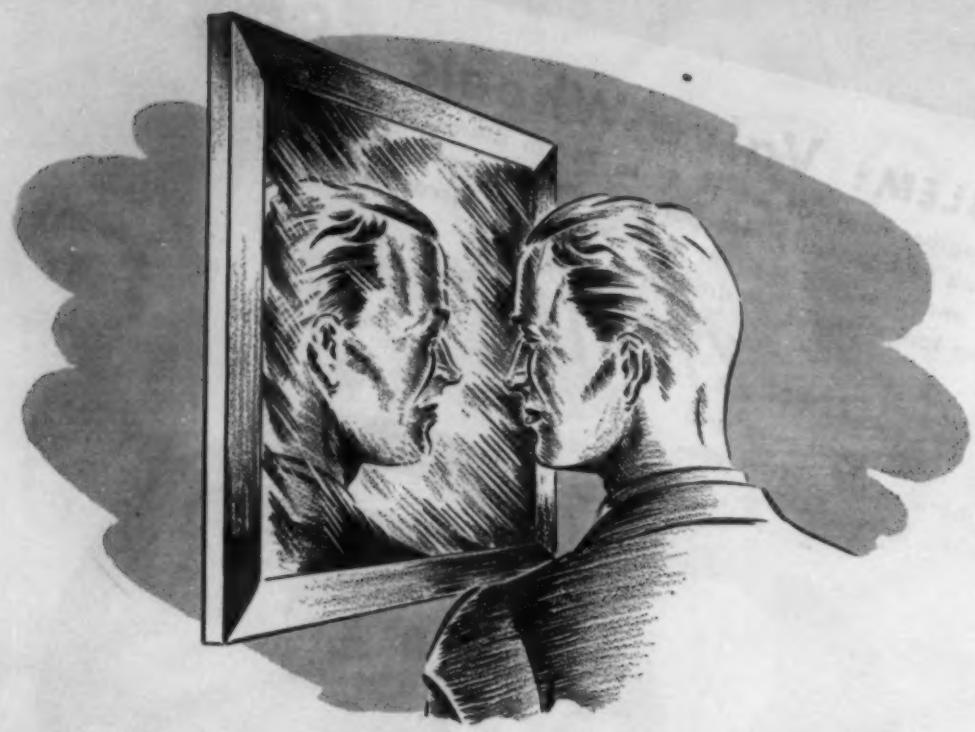
We will again be able to make products to your specifications as completed war contracts release our manufacturing facilities. The wait may not be long, and production is being scheduled as orders are placed. May we suggest you contact us promptly?

BUY WAR BONDS—AND KEEP THEM

KEYES FIBRE COMPANY

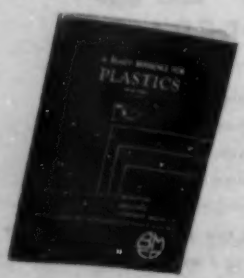
420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

(Plant at Waterville, Maine)



TO SOME PEOPLE WE'RE TWINS

"A Ready Reference for Plastics" written for the layman, is now in its seventh edition. If you are a user or a potential user of molded plastics, write us on your letterhead for a copy of this plain non-technical explanation of their uses and characteristics. Free to business firms and government services.



Most large buyers of molded parts make it a rule to have at least two sources of supply—you know, in case of fire, accident, act of God, etc.

But most of our customers—and some of them are fairly important industries—have selected us as their single source of plastics molding.

Does this sound like boasting? It is. We're proud of our plant construction—steel and concrete—our sprinkler system and even of our Insurance Company who keep us stepping so we don't have fires and accidents.

It's another small point to consider when you start selecting the outfit to mold for you.

BM CD

ARMY E NAVY

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

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NEW YORK OFFICE

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AIRCRAFT COWLING of acetate (LUMARITH, Celanese Celluloid Corp.) provides high clarity, filters out sun-burn rays.

CELLULOSE PLASTICS ARE *CLEAR* !

If what you need in a plastic is sparkling clarity, you will find it readily in the plastics based on cellulose. The clear transparency of the cellulose compounds adds brilliance to the field of plastics . . . offering high light transmission, freedom from particles and haze, clarity that yields sparkling colors in a comparatively limitless range.

As a leading producer of cellulose derivatives, Hercules is working constantly to raise even further the present high standards of brilliant clarity . . . and to develop each of the other properties which give cellulose plastics their unique combination of advantages. We do not ourselves make plastics but have literature and data, based on our years of research, which we will gladly send you. Please address Cellulose Products, Dept. MP-34,

Hercules Powder Company, Wilmington 99, Del.

HERCULES

CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

ECONOMICAL · STABLE · FLEXIBLE · CLEAR · TOUGH · LIGHTWEIGHT

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HERE VISUAL CLARITY is of prime importance. All gas-mask eye pieces are diecut from polished Cellulose Acetate sheet, for high light transmission and uniformity.

TRANSPARENCY of Cellulose plastics can be a convenience and time saver, as in this oil can for home and industrial use by The Eagle Manufacturing Company.

FREEDOM FROM PARTICLES is imperative in X-ray and other photographic film. Therefore they are made of brilliant-clear Cellulose Acetate and Cellulose Nitrate.

Will PLASTICS

Revolutionize Industry?

We do not think so, not for a long time at least, but we do expect plastics to assume far greater importance in post-war engineering, architecture, and manufacturing operations than ever before.

Plastics are not likely to perform miracles, but if your business or employment involves products of wood, leather, metal, paper fabrics, rubber, ceramics, or coating materials, *you cannot afford to ignore plastics in your post-war plans.*

The impetus of war research; the discovery of new materials and new methods; the eminently satisfactory performance of plastics in replacing older materials during war is bound to bring manufacturing economies and improved consumer goods when peace returns.

The intelligent use of plastics can be determined best by knowing their limitations as well as their advantages; by studying their make-up and physical properties; by recognizing the peculiar characteristics attributed to each type of plastics material.

Such knowledge and information is available through Educational Courses prepared and conducted by

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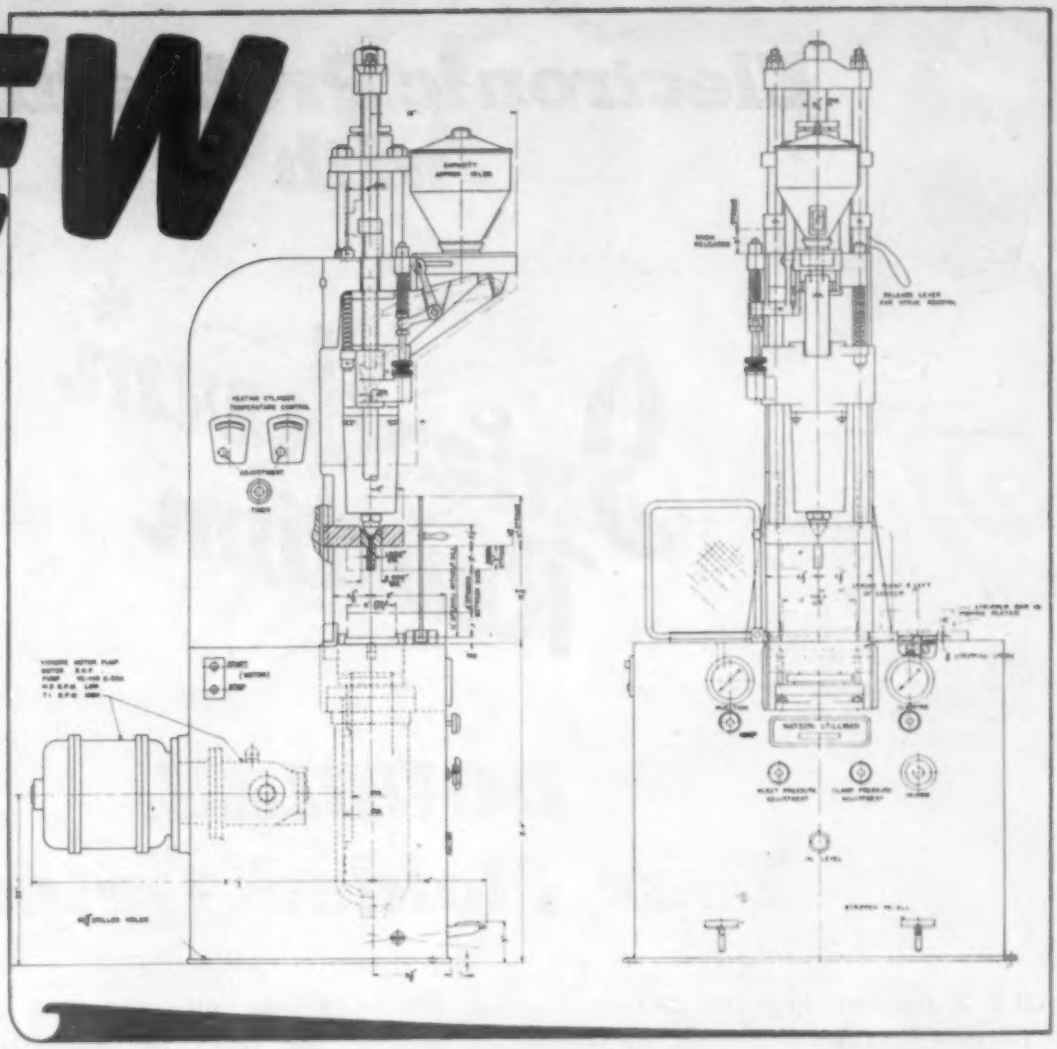


VERTICAL INJECTION MOLDING MACHINE

For Better Molding

OF SMALL PLASTIC PARTS

For molding thermo-plastic materials into small parts, with or without inserts or long leads, this new Watson-Stillman Vertical Injection Machine has outstanding advantages that speed production, cut costs. Its vertical C-frame with open front gives maximum accessibility to molds, and permits handling moldings with projecting inserts. All molding operations, including clamping and injection of material, are accomplished in one motion of the ram.

The machine is constructed so that a single top mold can be used with two bottom molds if desired. This permits positioning inserts in one mold while another is in the molding operation, thus speeding production. Material can be injected at any desired pressure without affecting the clamping pressure. This feature is also particularly desirable in transfer molding of thermo-setting materials.

An adjustable feed mechanism is self-compensating, accurately controlling the amount delivered to the cylinder. Both manual and fully automatic control are provided with timers for regulating operating cycles to suit any conditions. All operating hazards are eliminated by positive action safety devices incorporated in the new W-S Vertical Injection Molding Machine.

This new modernly-designed W-S Machine is furnished complete with electrical controls and self-contained power unit available in 2 and 4 oz. capacities. No molder's equipment is complete without this Vertical Automatic Molding Machine. Write for complete information today—and watch our next month's advertisement for an announcement on the improved W-S Horizontal Injection Machine.

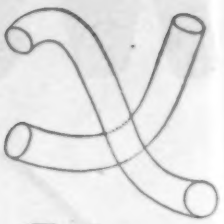
The Watson-Stillman Company, Roselle, N. J.

5391

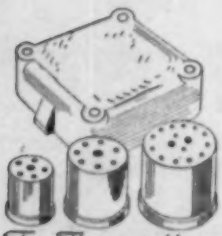
WATSON-STILLMAN Designers and manufacturers of Hydraulic Equipment and Machinery, Forged Steel Fittings and Valves.

Electronic Preheating with Intertherm* Reaction

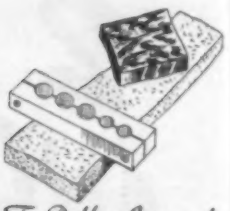
Pre-heated Thermosetting Preforms



For Heating and Shaping Thermoplastics



For Thermosetting Moldings



For Rubber Compounds

DOUBLES Your Molded Output

M & R dialectric high frequency heating—ELECTRONICS AT WORK—speeds production in both thermosetting and thermoplastic fields. Preheating thermosetting plastic preforms by "Intertherm Reaction"* (with automatic self-compensating electrodes) makes possible a DOUBLED production of larger pieces on the same press capacity, reduces flash and rejects to a minimum. Molded, stamped, and pressed thermoplastic parts are heated and produced faster and better. Among hundreds of other possible applications are the preheating of neoprene cork compounds, the treatment of natural rubber, the curing and preheating of synthetic rubber compounds, and the curing of resin-bonded grinding wheels.

Sturdy, all-metal M & R generators—complete and ready for installation in your plant—are available for fast delivery. In sizes and BTU ratings for every purpose, M & R models feature automatic timers, self-adjusting electrodes, all-metal construction, simplicity of control and a compact, portable design. Write Northwest Syndicate NOW for booklet, price-list and complete information. This company's continuing research program is devoted to helping you solve YOUR particular industrial heating problems through the proper use of RF generation.

*"Intertherm Reaction" is the M & R term meaning that the greatest concentration of heat is centered, balancing the external mold temperature with internal heat to provide fast, uniform flow characteristics.

★ **Northwest Syndicate Inc.** ★

A company operated by
Mann and Russell (M & R)

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LEA

Specialists in Cutting and Buffing Methods and Materials

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IN WAR

And for plastic war implements with which Lea Technicians have lent a helping hand, Bomber Noses made of PLEXIGLAS are much in the public eye right now.

LEA Technicians, skilled in the art of finishing surfaces of all kinds, have been very helpful to those working with plastics. Today, their service is doubly valuable in helping manufacturers to: *(1)* effectively meet more rigid specifications; *(2)* do the work faster; and *(3)* do it more economically.

Write us about your problem of cutting or buffing or any other step having to do with the finish of your plastic articles. We have the experience and materials with which to help you.

THE LEA MANUFACTURING CO.

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the development of Production Methods and Compositions

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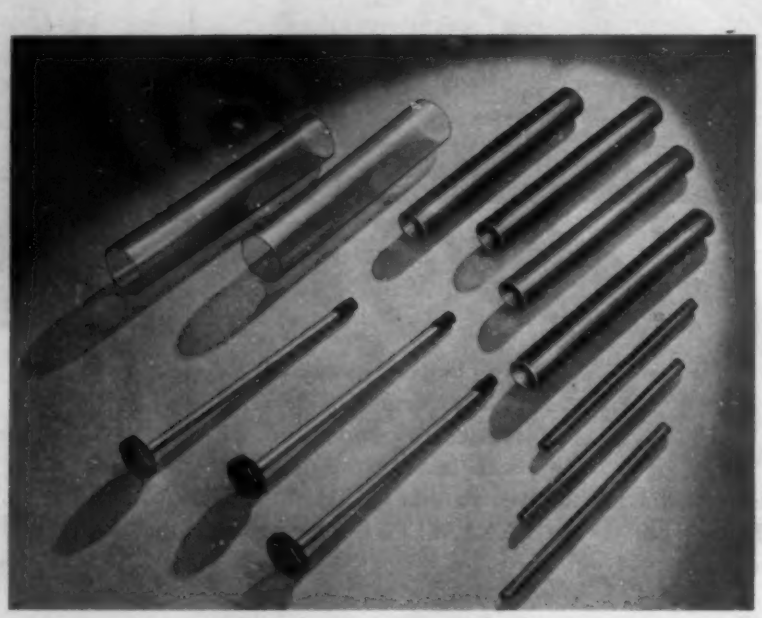
EXTRUSION *and* INJECTION MOLDING

← Injection molding of intricate or complex forms has given us experience of practical value in ALL types of thermoplastics. Intelligent designing of molds, thorough knowledge of molding technique, and sustained production for prompt delivery are fundamentals of Celluplastic service during 25 years of manufacturing experience.



Extrusion molding in continuous lengths, flexible or rigid in any color or dimension. Opaque or transparent; thick or thin walled, solid or hollow.

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A modern plant with great capacity, under skilled supervision, serving the field for over 25 years!

And an expert Engineering Staff at your command.

FIRST IN CELLUPLASTICS

HYCOLOID-CLEARSITE

CELLUPLASTIC CORPORATION

EXTRUSION AND INJECTION MOLDERS

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"Plexiglas"

a motion picture...with sound

WITHOUT injecting sales talk, the Rohm & Haas Company has produced a sound film on the maintenance and repair of PLEXIGLAS.

It's a factual, semi-technical film designed to facilitate the use of PLEXIGLAS in war production. It already has been shown in more than 150 Army Air Force bases as an aid to ground crew instruction.

The opportunity is offered to the aircraft industry and to educational institutions to borrow a print of this interesting 16 mm. sound film. Using your letterhead, write Rohm & Haas Company, Washington Square, Philadelphia 5, Pa., giving your first and second choice of dates and the approximate length of time you expect to use it.

FABRICATION

MAINTENANCE

REPAIR

PLEXIGLAS is a trade-mark, Reg. U. S. Pat. Off., for an acrylic resin thermoplastic manufactured by the Rohm & Haas Company.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . Synthetic Insecticides . Fungicides . Enzymes . Chemicals for the Leather, Textile and other Industries

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PRACTICAL new ideas in chemistry, as your own experience probably proves, come from a rich background of *doing*.

Here at Emery, we've been at it for 103 instructive years, and our "young" ideas about different or improved products have that much seasoning behind them. Some of these ideas may appeal to you. We'd like to work with you to find out.

Organic chemistry being what it is, we'll put our proposal this way: If you make anything that calls for a fatty acid or fatty acid derivative . . . if you are interested in mono- and dibasic aliphatic acids, or their esters, which combine high boiling points with a good range of compatibility with resins, you may find it rewarding to talk to our laboratory.

Stimulating our young ideas, we have complete records of case histories on all our products and their uses. Probably some item in this storehouse of information will be helpful in your particular process.

While some of our new products, like azelaic and pelargonic acids, may not be readily available until after "that day", we invite you to explore with us now the possibilities of making your product better or at lower cost through the use of Emery's high-quality products.

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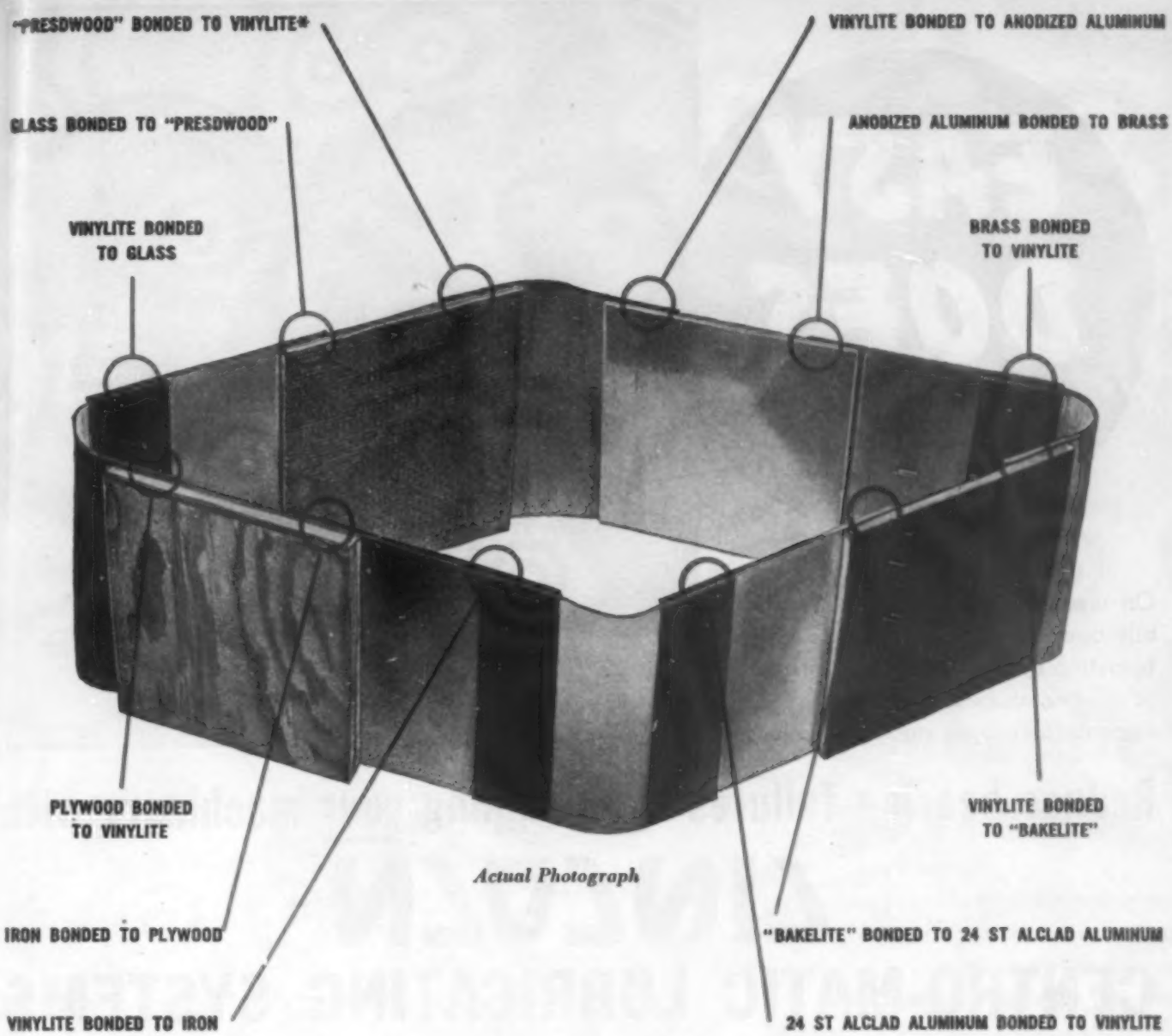
BUY WAR SAVINGS STAMPS AND BONDS EVERY PAYDAY


"PRESDWOOD" BONDED TO VINYLITE*
VINYLITE BONDED TO ANODIZED ALUMINUM
GLASS BONDED TO "PRESDWOOD"
ANODIZED ALUMINUM BONDED TO BRASS
VINYLITE BONDED TO GLASS
BRASS BONDED TO VINYLITE
PLYWOOD BONDED TO VINYLITE
VINYLITE BONDED TO "BAKELITE"
IRON BONDED TO PLYWOOD
"BAKELITE" BONDED TO 24 ST ALCLAD ALUMINUM
VINYLITE BONDED TO IRON
24 ST ALCLAD ALUMINUM BONDED TO VINYLITE

Actual Photograph

All True Bonds with CORDO Adhesives

CORDO Adhesives insure true bonds with plastics, glass, woods, metals—rigid or flexible—to each other and to one another.

Unusual bonding strengths are attained—approaching and, in some combinations, equalling or exceeding the strengths of the materials being bonded.

The CORDO research laboratories developed these adhesives to meet specific bonding needs. They perhaps can help to solve your present or post-war bonding problems.

Please write, giving full details: bond strengths and service requirements, materials used, pressure and baking methods available.

*VINYLITE IS THE REGISTERED TRADE MARK OF CARBIDE AND CARBON CHEMICALS CORPORATION

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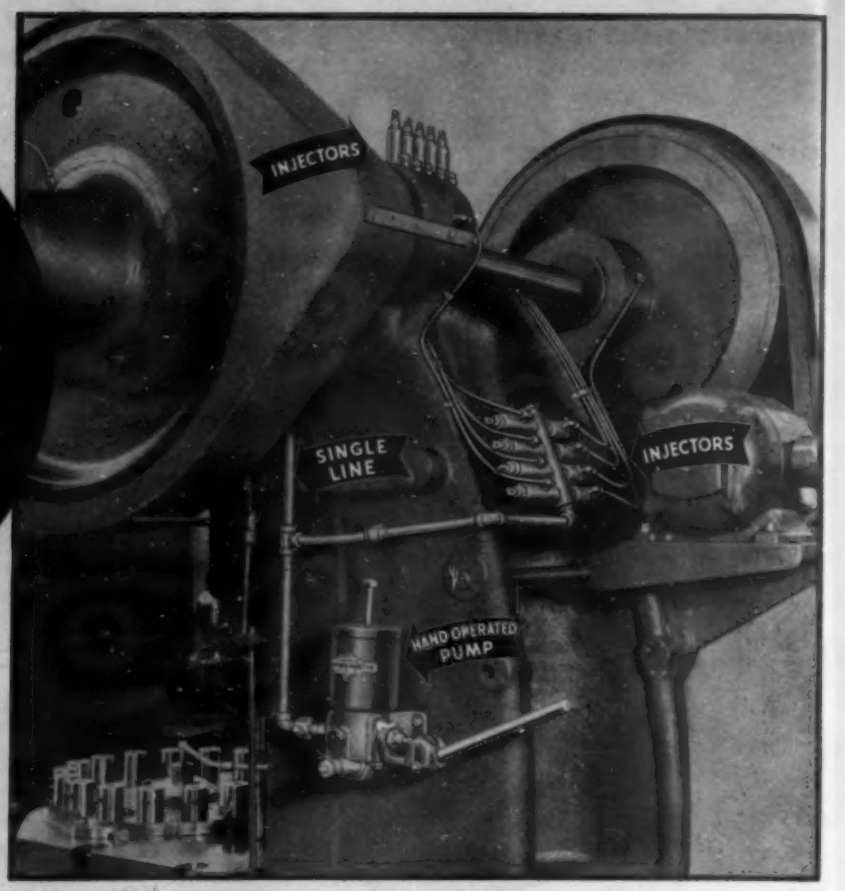
34 Smith Street, Norwalk, Connecticut
INDUSTRIAL COATINGS • FINISHES • INDUSTRIAL ADHESIVES

CORDO

EASY DOES IT!



On machines equipped with manually operated Lincoln centralized lubrication system—*just a few strokes of a lever,* and each and every bearing gets the proper amount of grease.

Reduce bearing failures by equipping your machinery with

LINCOLN

CENTRO-MATIC LUBRICATING SYSTEMS

Save time... Save effort... Save manpower... Reduce bearing failures . . . Eliminate the need for shutting down production line machinery in order to lubricate bearings requiring grease lubrication. It's possible when machines are equipped with the Lincoln modern method of *centralized* lubrication.

A Centro-Matic System makes it possible for one man to lubricate *all* bearings in a fraction of the time it would take to contact each individual bearing.

A Centro-Matic System consists of a number of Centro-Matic Injectors—one for each bearing—and a power operated or a hand operated Centro-Matic Lubricant Pump. A power operated system can be either time clock control or push button control . . . The injectors can be grouped in manifold or located separately at each bearing. In either arrangement only a single lubricant supply line is required . . . Can be easily installed on new or old machines.

The ARMY-NAVY PRODUCTION AWARD for high achievement in the production of war equipment, conferred upon the Lincoln Engineering Company has had two stars added. Each of these stars symbolizes 6 additional months of exacting service to our Armed Forces, delivering vital materials so necessary for ultimate Victory.

Write us today for complete information

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Pioneer Builders of Engineered Lubricating Equipment

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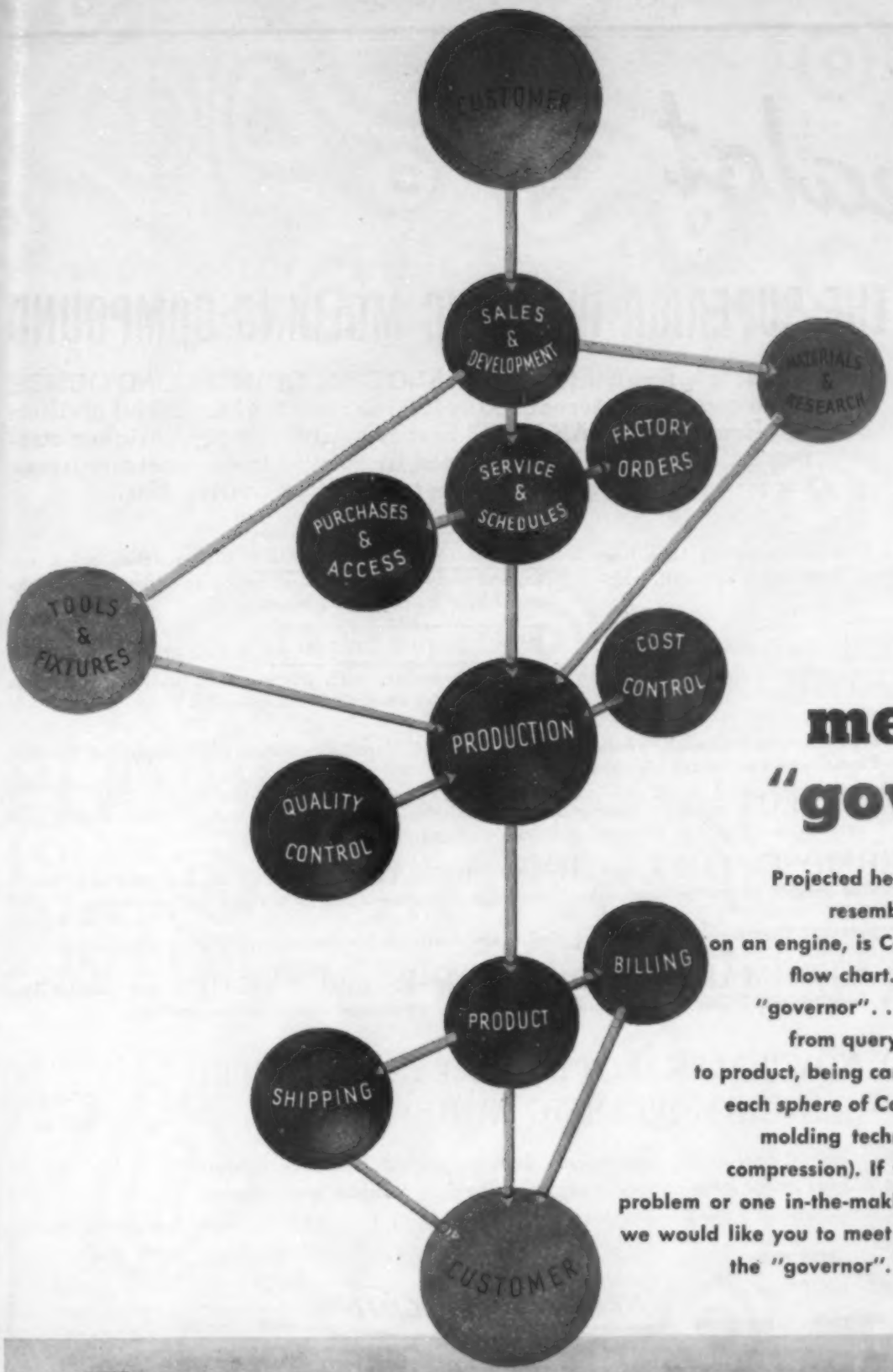

meet the "governor"

Projected here in third dimension and resembling the governor control on an engine, is Consolidated's operational flow chart. In function this, too, is a "governor". . . the customer's interest, from query to quote and from order to product, being carefully controlled through each *sphere* of Consolidated's experienced molding techniques (injection transfer compression). If you've a present plastics problem or one in-the-making, we would like you to meet the "governor".

Consolidated

MOLDED PRODUCTS *Corporation*

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Makalot

THE SUPERIOR PHENOLIC MOLDING COMPOUND

These representative MAKALOT MOLDING COMPOUNDS have especial interest today in war uses and essential civilian applications. MAKALOT features uniformity, quicker curing and improved appearance in compounds, custom-made for your requirements. One trial will convince you.

1040—Low Loss The best molding Low Loss compound available for high frequency, ignition, electronic parts, etc.

1163 Gen. Purpose Unsurpassed in molding and final quality. Has what every molder wants for trouble-free production.

1962 Non Cracking Will neither crack nor expand away from inserts, either large or small. Supreme in its field for the past 7 years.

93C Super Impact Fabric filled for compression or transfer, with flowing and molding qualities equal to most wood-filled compounds.

K.E.M. The only proved successful phenolic replacement compound! Especially indicated for Essential Civilian Uses where Phenol and Formaldehyde must be conserved.

REMEMBER! MAKALOT molding compounds are available for acid, alkali, water, electrical and heat resistance. Tailored for each and every purpose.

MAKALOT THERMOSETTING RESINS and VARNISHES are featured as solids or in oil or water-soluble forms for laminating, insulating, impregnating or coating applications.

MAKALOT low temperature thermosetting Phenolic Resins are available for coating and plywood applications.

MAKALOT UREA-FORMALDEHYDE CREAMS and SYRUPS are outstanding for Textile, Leather and Paper uses. You can count on their dependable uniform quality.

AND NOW!! MAKALOT'S NEWLY DEVELOPED THERMOPLASTIC ADHESIVES

For both air or heat-drying conditions. Imparts perfect resistance against water, alcohol and a wide variety of organic solvents. Samples upon request.

"KEEP 'EM MOLDING"

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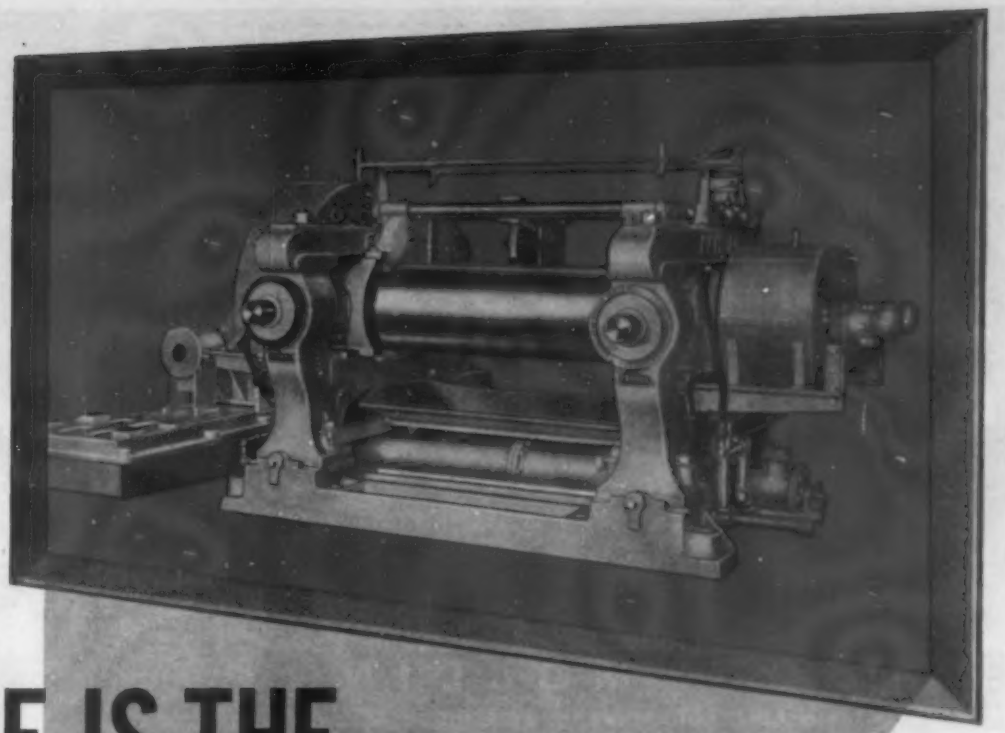
The Independent Producer of Superior Plastics



HERE IS THE PLASTICS MILL PICTURE... AS OF TODAY

FARREL-BIRMINGHAM Roll Mills have kept pace with the many rapid changes in the plastics industry. When developments called for heavier equipment for converting and mixing at higher temperatures, new designs were immediately made available.

The 22" x 60" heavy duty mill "pictured" above is a good example of modern design. Rolls are chilled iron, chamber-bored, and fitted with a special type of stuffing box designed for high temperature. For stocks which are sensitive to contamination, the rolls are chrome-plated and other parts (such as the adjustable guides and the mill pan under the rolls) which come in contact with the stock are made of non-corroding metals. Attachments and equipment to suit a particular function or to meet unusual production needs are supplied when required.

The adjustable guides can be provided with a special ratchet adjustment to raise them vertically to permit cleaning the rolls as well as the undersides of the guides themselves. To prevent breakage of housings and other parts in case of overloading, a patented shear pin safety device is fitted between the adjusting screws and front roll boxes. A pull-back attachment permits adjustment of the rolls forward as well as back. Graduated dials on the adjusting screws indicate amount of movement of the front roll. Specially designed teeth of the connecting spur gears permit maximum opening between rolls.

Farrel-Birmingham Plastics Mills are made in a complete range of sizes from 8" x 16" for the laboratory up to 28" x 84" heavy duty mills for the factory. Write for complete information.

F-B PLASTICS MACHINERY

- Banbury Internal Mixers
- Roll Mills
- Converting, Mixing and Sheeting Rolls
- Calenders
- Extruding Machines
- Hydraulic Presses
- Hydraulic Accumulators
- Sheet Cutters or Planers

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Branch Offices: New York, Buffalo, Pittsburgh, Akron, Los Angeles

Farrel-Birmingham

No matter what your problem is ...It can be done!

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INJECTION MOLDING

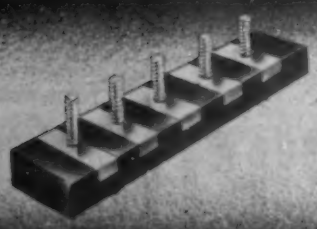
METHYL-METHACRYLATE. NYLON. POLYSTYRENE. CELLULOSE ACETATE

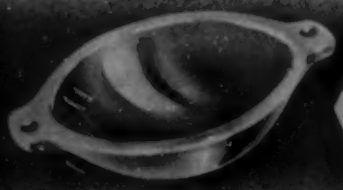
FABRICATION

PHENOL-FORMALDEHYDE. POLYSTYRENE. METHYL-METHACRYLATE.

COMPRESSION MOLDING

PHENOL-FORMALDEHYDE. METHYL-METHACRYLATE. UREA-FORMALDEHYDE





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PHENOL-FORMALDEHYDE. CELLULOSE ACETATE. METHYL-METHACRYLATE.

"COMPONENT MOLDING"

ANY COMBINATION OF THERMOPLASTIC AND METAL

METAL INSERTS

MACHINED IN OUR SHOP FOR THE ABOVE

Extremely close tolerances maintained.

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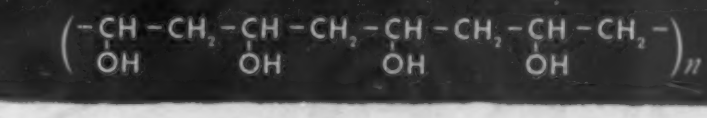
DU PONT PRODUCTS YOU SHOULD INVESTIGATE

POLYVINYL ALCOHOL



A WHITE to cream-colored powder, bulk density 0.4 to 0.6 (Sp. Gr. 1.21 to 1.31). Not attacked by bacteria or fungi under ordinary conditions. Can be blended with pigments, fillers and plasticizers for extrusion and molding into finished articles, or sheets that may be used as preforms for molding, or stamped into finished objects.

OUTSTANDING CHARACTERISTICS

Solid—Can be used with or without plasticizers, fillers or other modifiers to produce rubber-like masses of Shore Hardness 10 to over 100. The molding can be carried out at 250° to 300°F. at pressures of from 500 to 1500 psi. The moldings are transparent or translucent depending on the filler, and are tough, resilient, flexible and extremely resistant to abrasion.

Aqueous Solutions—Viscosity and solid content may be varied independently over a wide range. These solutions are compatible with plasticizers, wetting agents and other ingredients commonly used as adhesives and binders. They can be readily dispersed in mixtures of fillers, paper pulp, sand, clay and ceramic mixtures.

Films and Coatings—Readily obtained by spraying, dipping or coating and subsequent evaporization of water. They are characterized by transparency, strength, toughness, abrasion resistance, impermeability to gases and vapors other than water vapor, high tensile and tear strength, self-sealing properties and resistance to all common oils, fats, waxes and organic solvents. They are swelled by water and can be made water-resistant but not water-proof.

ALSO . . .

POLYVINYL ACETATE and POLYVINYL ACETATE EMULSIONS

Investigate further the properties and applications of Du Pont Polyvinyl Alcohol, Acetate and Acetate Emulsions for use in your own development and process work. For complete information, just clip the coupon below.

DU PONT
REG. U. S. PAT. OFF.

TYPICAL APPLICATIONS

The molded or extruded products can be used for gas-, grease-, solvent-proof tubing; washers; gaskets; diaphragms and printing rollers. The water solutions have pronounced emulsifying, adhesive and film-forming properties, hence could be used for preparation of special adhesives such as binders for ceramic materials, paper coatings, textile sizing; for emulsifying oils, fats and waxes; as binders and leather dressings; cosmetic and pharmaceutical formulations; for dip, spray and machine coating of threads, fabrics, papers, metals, leather, etc.; for grease-proofing paper, fabric and leather; sizes for reproducing special printing papers; to impregnate fabrics and other materials to make laminates in sheet form; photosensitive coatings for printing plates and decorating stencils.

* * * *

Several grades of Polyvinyl Alcohol, each differing in physical and chemical properties, are commercially available, thus permitting a selection of the grade which is best suited to a particular application. At the present time the use of Polyvinyl Alcohol is restricted to uses covered by GPO-M-10. Small amounts, however, can be obtained for research and experimental investigations.

LET'S ALL BACK THE ATTACK!

E. I. du Pont de Nemours & Co. (Inc.), MP-1
Electrochemicals Department,
Wilmington 98, Delaware
Please send me information on Polyvinyl Alcohol.
Name..... *Title*.....
Firm.....
Address.....

DU PONT ELECTROCHEMICALS

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

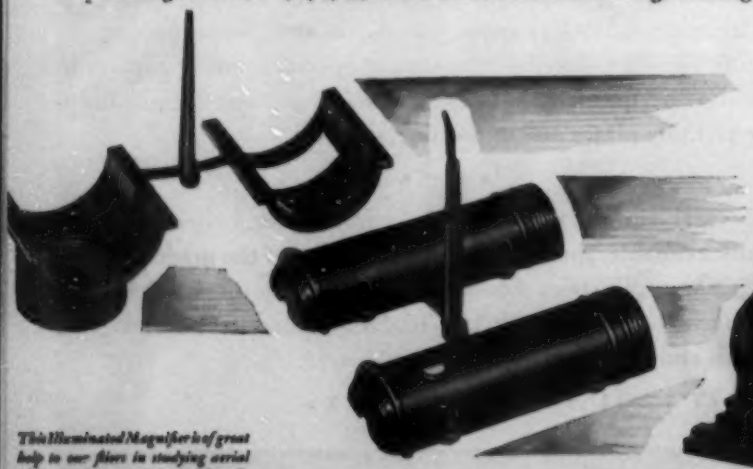
You've got to SPOT 'EM before you SOCK 'EM

When an American bombardier calls, "Bombs away," he can be pretty sure that his bombs will fall accurately on the target. That is because he has used the best bombsight in the world. Not only that, but he has studied his maps and aerial photographs until the target is as familiar to him as his own back yard.

One of the handiest tools yet developed for day or night study of maps and photos is the Illuminated Magnifier, injection molded by Recto Molded Products, Inc., Cincinnati, Ohio, for Advertising Displays, Inc., Covington, Ky. The case and handle of the instrument are molded of cellulose acetate butyrate on a 4-ounce size Lester Injection Molding Machine at a production rate of 2½ cycles a minute.

There is a reason why Lesters are preferred for accurate, day in—day out production. The reputation of Lester Injection Molding Machines for profit-making output is built solidly on sound, basic engineering* design. Start your post-war plans with an investigation of the Lester line. Write today for complete data.

* Here's why Lesters are high producers: (1) Vertical heating cylinder with hollow injection plunger results in high heating efficiency. (2) Extra, interchangeable heating cylinders, available for each model, extend operating range. (3) Positive die locking mechanism reduces flash on moldings to rock bottom minimum. (4) Perfect parallelism of die plates assured by central die adjustment. (5) Sturdy alloy steel beam frame gives rigid support to die locking mechanism. (6) Complete range of sizes—4, 6, 8, 12, 16 and the 22-ounce size for large moldings.



This Illuminated Magnifier is of great help to our fliers in studying aerial photos and maps. Case and handle are molded on a 4-ounce Lester.

The 4-ounce size Lester Injection Molding Machine is the smallest in the Lester line. Five other standard sizes range in capacity up to 22 ounces.

...ESTER-PHOENIX INC.
...11 CHURCH AVENUE
CLEVELAND, OHIO

LESTER

INJECTION MOLDING MACHINES

Representatives in:
NEW YORK CITY • DETROIT
LEOMINSTER • LOS ANGELES
CHICAGO • SAN FRANCISCO
CINCINNATI
Foreign Agents:
BOWDING & DOLL, LTD.,
LONDON, ENGLAND
SCOTT & HOLLADAY PTY. LTD.
SYDNEY, AUSTRALIA

Our Trademark now becomes our Company Name

295 MADISON AVENUE

NEW YORK

WE WISH TO ANNOUNCE THAT OUR FIRM NAME OF

WISHNICK-TUMPEER, INC.

HAS BEEN CHANGED TO

WITCO CHEMICAL COMPANY

THIS CHANGE DOES NOT AFFECT THE CORPORATE STRUCTURE, MANAGEMENT, PERSONNEL, OR POLICIES OF OUR COMPANY

WITCO CHEMICAL COMPANY

MANUFACTURERS AND EXPORTERS

295 MADISON AVENUE, NEW YORK 17, N. Y.

Boston • Chicago • Cleveland • Akron • Detroit • London

Post War PLASTIC Sales

... A sound capital structure is required to finance broad post war markets. Alert management is investigating factoring — the streamlined banking of prosperous industry.

BOOKLET ON REQUEST

COLEMAN & COMPANY

FACTORS · ESTABLISHED 1912

468 FOURTH AVENUE • NEW YORK CITY

Remember....?

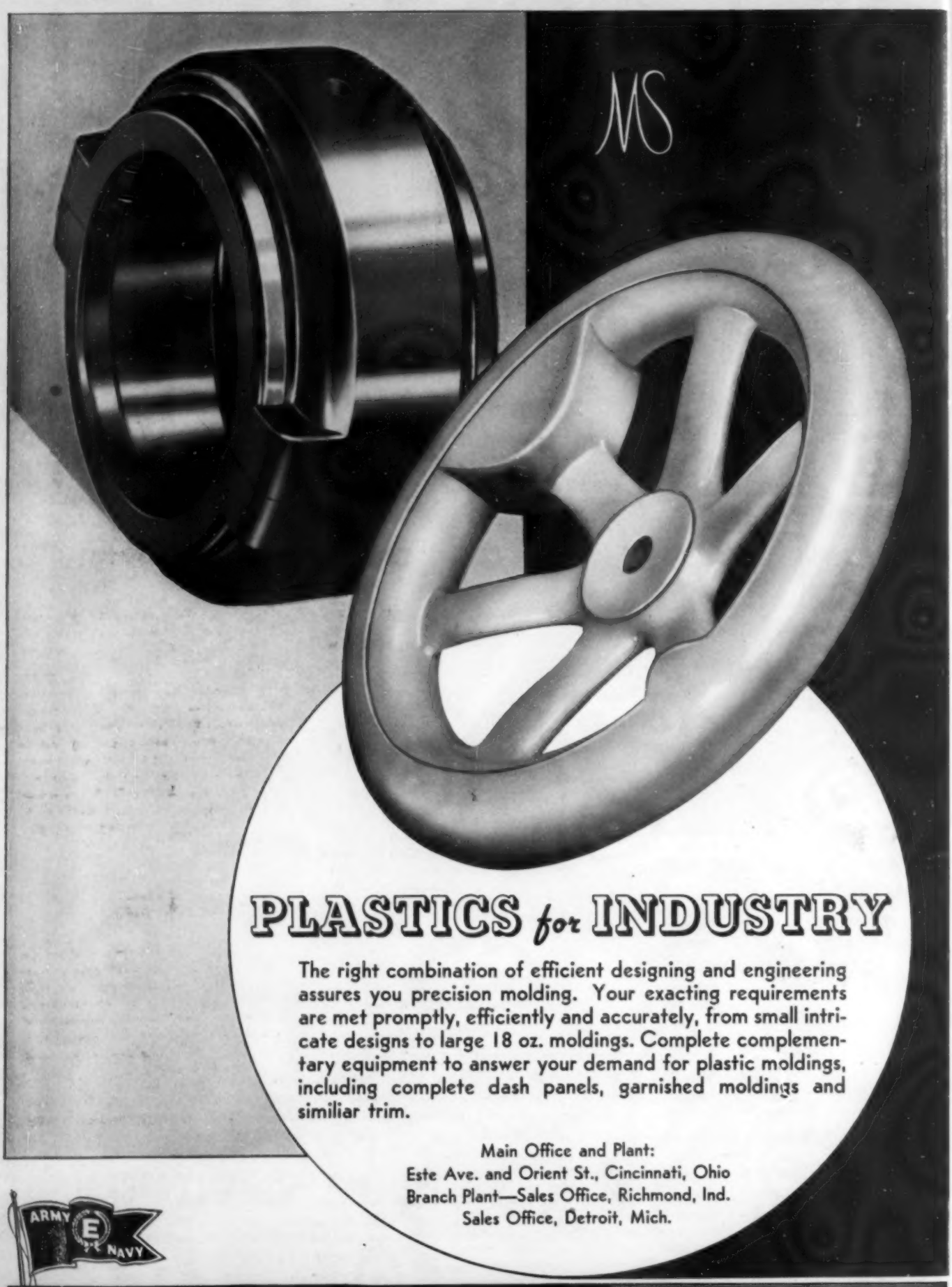
Here in full color are reproduced the splendor and beauty and salability of some of the thermoplastic products created by our organization in the days before allocation and priorities. When the war is over and machines and manpower are converted into instruments of peace, the new methods and materials developed during wartime will be available to our post-war customers. In the meantime, we will be glad to assist you with any war or post-war problems.

For information regarding the MILLS-PLASTIC* tubing and fittings, shown below, write on your letterhead for circular containing such data and illustrations; or, you may write for the new catalog on Injection Molded and Extruded Plastics. *Made of Saran.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials

153 W. HURON STREET, CHICAGO 10, ILLINOIS



PLASTICS for INDUSTRY

The right combination of efficient designing and engineering assures you precision molding. Your exacting requirements are met promptly, efficiently and accurately, from small intricate designs to large 18 oz. moldings. Complete complementary equipment to answer your demand for plastic moldings, including complete dash panels, garnished moldings and similiar trim.

Main Office and Plant:
Este Ave. and Orient St., Cincinnati, Ohio
Branch Plant—Sales Office, Richmond, Ind.
Sales Office, Detroit, Mich.

ARMY E NAVY

The METAL SPECIALTY Co. PLASTIC DIVISION
MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO

HOW WOULD YOU SOLVE THIS PROBLEM?

Does too much talk about plastics made from corncobs, straw and other farmyard waste help or harm the plastics industry?

Granted that favorable publicity for plastics is altogether desirable, it still seems to us that many Sunday feature stories about postwar plastics grown on the farm belong in a class with those on the all-plastic automobile. Unless carefully qualified, they lead to widely popular but potentially harmful misconceptions about the nature and future of plastics.

In this, the third in a series of advertisements addressed to the business executives who will be the plastics industry's postwar customers, we have tried to head off some of those misconceptions.

Undoubtedly many important advances of very real significance to the industry will result from the work now being done on materials based wholly or in part on agricultural products. The public should realize, however, that the mere fact you may be able to convert corncobs and straw into plastics does not mean that plastics themselves will therefore soon be as cheap and plentiful as corncobs and straw.

Plastics cannot be successfully sold on a price-per-pound basis. What our industry has to sell are not low-cost fabricating materials but *production savings*, which often result in lower costs for the finished products, and *product improvements*, which often result in greater sales appeal in the finished product.

If we let our prospects get the impression that we are in the salvage business . . . that postwar plastics will be made principally from waste materials . . . and that plastics will be so cheap and plentiful they will revolutionize postwar industry . . . then *all* of us in the plastics industry are in for some painful postwar headaches.

Right now seems to be none too soon to correct such misconceptions.

Are we right?

We will be glad to have *your* reaction—on a postcard or in a four-page letter.

Plastics – *not recommended* for spring planting

Cotton fibres, too short for spinning, are the chief raw material for two of the oldest and most widely used groups of modern, synthetic plastics. To a lesser degree, oat hulls, corncobs, spent sugar cane, rice hulls, soy bean hulls, tobacco stalks and similar waste products of the farm have contributed successfully to commercial or experimental plastics.

But when you read glowing prophecies of incredibly cheap and plentiful plastics made from farm waste, please don't follow the prophets too literally out the window and into the clouds—at least not when you are planning the products you hope to build and sell in the critical years just after victory.

Whatever the basic raw material, a modern, synthetic plastic is primarily a *chemical* product. Its cost and its availability depend at least as much on the relative complexity of the chemical processes required to produce it, as on the cost and availability of the basic raw materials.

For example, Monsanto's Lustron, one of the lightest, most colorful, most versatile and potentially most plentiful of plastics comes from crude oil by way of styrene—a much less dramatic source than oat hulls or soy beans. Yet there is every reason to believe that it will cost less to mold a product from Lustron after victory than from any other comparable plastic!

In the light of these facts, wouldn't you say that a plastics producer with a broad and varied chemical background could probably give you the best advice on how plastics may contribute to your war or postwar products? . . . Particularly a producer like Monsanto, which offers one of the largest and most versatile groups of plastics of any of the major chemical companies? MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

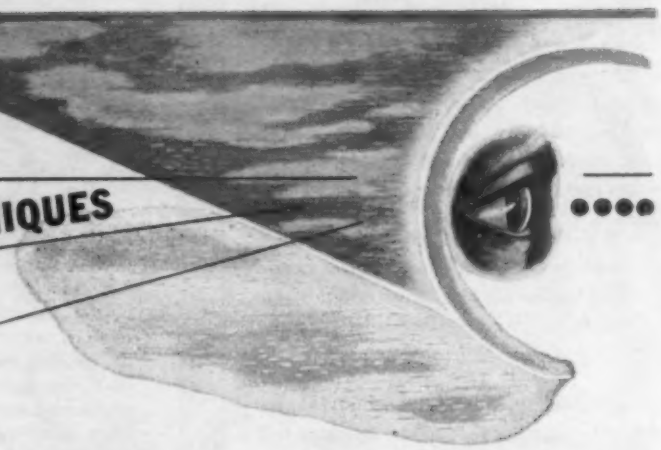
★ ★ ★

The broad and versatile family of Monsanto Plastics includes: Lustron polystyrenes • Vinyl acetals Nitron cellulose nitrates • Fibestos cellulose acetates • Opalon cast phenolics • Resinox phenolic compounds • Resimene melamine compounds Forms in which they are supplied include: sheets • rods • tubes • molding compounds castings • industrial resins • coating compounds Vuepak rigid transparent packaging materials.

MONSANTO
PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

SEARCHRAY enables you to

SEE THINGS YOU NEVER



INSPECT YOUR MATERIALS

DEVELOP MANUFACTURING TECHNIQUES

SAVE TIME AND MONEY

● SEARCHRAY is a new, compact inspection tool that enables you to examine *internally* plastics, light metals, rubber, ceramics and other materials; to inspect castings, parts, assemblies and sub-assemblies; to locate hidden flaws and imperfections; to check on production and improve it; to correct defects in structure and assembly *before* production begins; to improve your product, cut costs, and strengthen your competitive situation.

Shockproof, rayproof, portable and self-contained, Searchray gives industry all the benefits of X-ray inspection *without* the expense and inconvenience of a special lead-lined room and an X-ray technician. Even an unskilled operator can learn to use it in a few minutes.

In short, Searchray is a new "handy man" for industry—equally valuable on the assembly line or in the industrial laboratory as a check on production methods. 80 kilovolts enable the smaller, portable unit, Searchray 80, to see through the lighter metals, plastics, and other light materials and parts. For heavier duty, Searchray 150 is recommended, especially where exacting X-ray photographs are required.

Modernize your production by putting Searchray to work in your plant. Let us tell you how Searchray and other NORELCO electronic products can help you.

For Our Armed Forces we make Quartz Oscillator Plates; Amplifier, Transmitting, Rectifier and Cathode Ray Tubes for land, sea and air-borne communications equipment.

For Our War Industries we make X-ray Diffraction Apparatus; Electronic Temperature Indicators; Direct Reading Frequency Meters; Electronic Measuring Instruments; High Frequency Heating Equipment; Tungsten and Molybdenum in powder, rod, wire and sheet form; Tungsten Alloys; Fine Wire of practically all drawable metals and alloys: bare, plated and enameled; Diamond Dies.

And for Victory we say: Buy More War Bonds.

Norelco **ELECTRONIC PRODUCTS by**
NORTH AMERICAN PHILIPS COMPANY, INC.

Executive Offices: 100 East 42nd Street, New York 17, New York
Factories in Dobbs Ferry, N. Y.; Mount Vernon, N. Y. (Metalix Division); Lewiston, Maine (Elmet Division)
Represented in Canada by Electrical Trading Company, Ltd., Sun Life Building, Montreal, Centre 2, Canada

SAW BEFORE

Searchray photograph of plastic high tension insulator showing flaw due to improper curing

SEARCHRAY 150

SEARCHRAY 80

80 KvP

150 KvP

HYDRAULICS Rodgers KEEP THE WORLD MOVING

Manufacturers of:

UNIVERSAL HYDRAULIC PRESSES
TRACK PRESS EQUIPMENT
HYDRAULIC KEEL BENDERS
HYDROSTATIC TEST UNITS
POWER TRACK WRENCHES
HYDRAULIC PLASTIC PRESSES
PORTABLE STRAIGHTENER
FOR PIPE AND KELLYS

On the March!

THE PLASTICS INDUSTRY has completely mastered the problem of conversion to war production. Plastics are on the march in many thousands of ways on land, at sea and in the air. Here is a giant industry that promises startling new developments for civilian use. The possibilities that lie ahead for plastics in the post war world stagger the imagination.

If you are now engaged in the manufacture of plastics or are considering this field in your Post War Planning, remember the name Rodgers. In the meantime, we too are on the march for our country. ***If it's a Rodgers, it's the best in Hydraulics.*** Rodgers Hydraulic Inc., St. Louis Park, Minneapolis 16, Minnesota.

Rodgers HYDRAULIC Inc.

for Dependability!

DURITE

Reg. U. S. Pat. Off.

Plastics of Outstanding Quality to Meet Today's Production Needs

RESINS . . .

Phenol-Formaldehyde and Phenol-Furfural synthetic resins for every purpose

MOLDING COMPOUNDS . . .

Complete line of Phenol-Formaldehyde and Phenol-Furfural molding powders

CEMENTS . . .

Used universally in the manufacture of incandescent lamps, radio tubes and electronic equipment

ADHESIVES . . .

Plywood . . . for hot and cold press bonding

OIL SOLUBLE RESINS . . .

For production of air-drying or baking varnishes, protective coatings and finishes

WATER SOLUBLE RESINS . .

For a wide variety of impregnating, coating and bonding applications

PLUS! . . . DURITE RESEARCH . . .

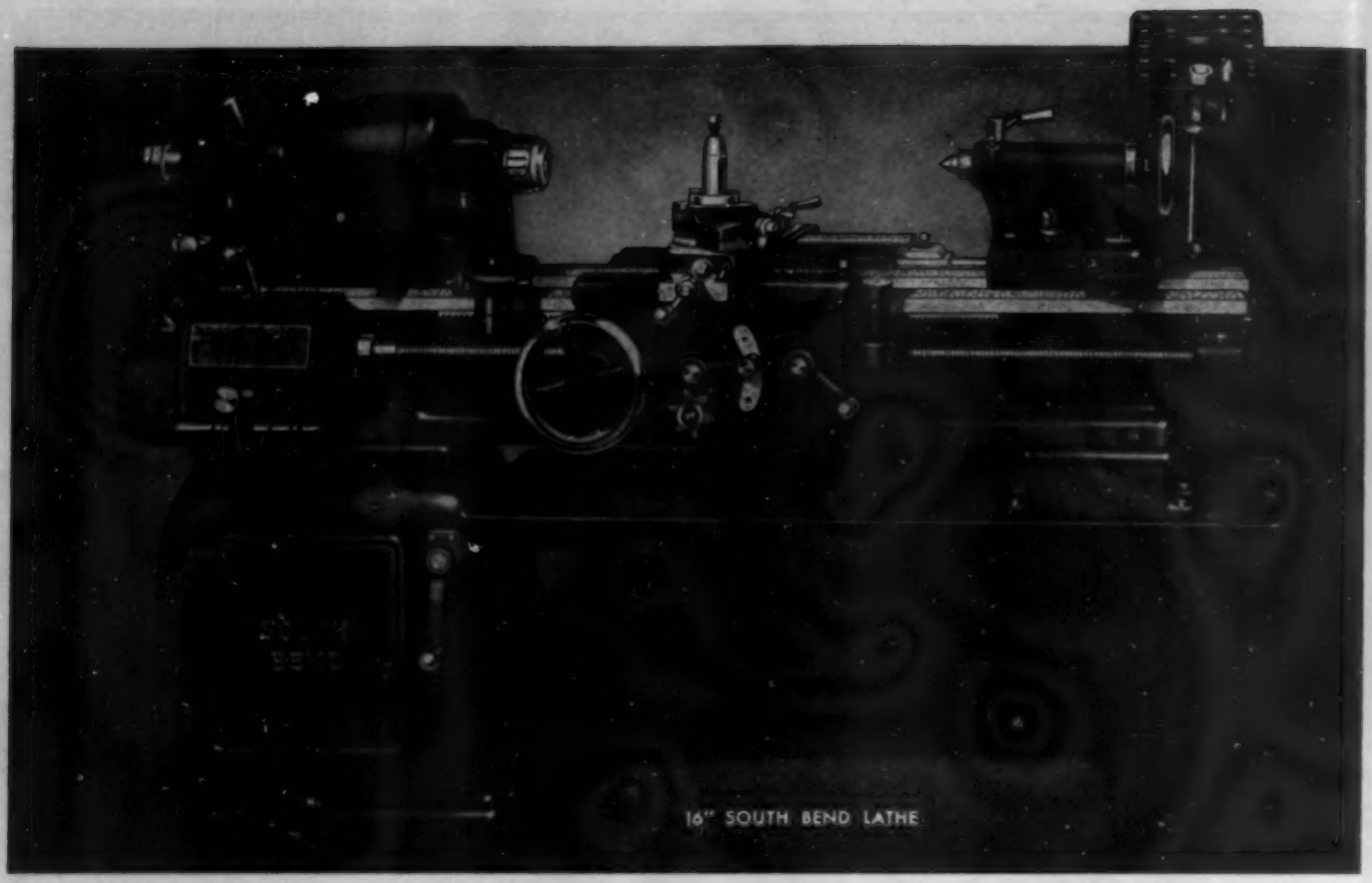
The DURITE laboratories are among the most modern and best equipped in the country and have won a national reputation for research and development in plastics. You are invited to refer any of your plastic problems to our engineers.

DURITE PLASTICS

INCORPORATED

FRANKFORD STATION P. O. PHILADELPHIA 24, PA.

SYNTHETIC RUBBER COMPOUNDS PHENOL-FURFURAL PRODUCTS PHENOL FORMALDEHYDE PRODUCTS



16" SOUTH BEND LATHE

SOUTH BEND LATHES

FOR UNIFORM ACCURACY

SPECIFICATIONS of 16" lathe

Swing over bed	16¼"
Distance between centers	33½"
Maximum collet capacity	1"
Hole through spindle	1⅜"
Thread cutting feeds (48)	4 to 224 per inch
Spindle speeds (8)	21 to 725 r. p. m.
Power longitudinal and cross feeds	48

BUY WAR BONDS

WAR PRODUCTION demands uniform accuracy. The loss of time or the waste of scarce strategic materials because of variations in machining cannot be tolerated. There is no place in our war production plan for equipment that cannot be relied upon to maintain the required tolerances.

Sound design and careful workmanship give South Bend Lathes the dependable precision that assures uniform accuracy at all times and speeds-up production on the most exacting machining operations.

South Bend Engine Lathes and Toolroom Lathes are made with 9", 10", 13", 14½", and 16" swings, with bed lengths from 3' to 12'. The Turret Lathes are made with 9" and 10" swings. Write for Catalog No. 100-C in which they are all described and illustrated.

TRAINING HELPS — Sound films, books, wall charts, and bulletins are available for training lathe operators. Write for Bulletin No. 21-C.

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 37 YEARS • SOUTH BEND 22, IND.

Plastic PILLBOXES...

Millions of these tiny transparent vials help keep soldiers' water safe

Not pillboxes containing machine-guns for defensive warfare—but little transparent vials for pills that combat and defeat disease for advancing allied armies. Every little "pillbox" in the clip of five carried by a soldier at the front contains two tiny pills—enough to purify a full canteen of water. They are the answer to the army's search for a bulkless, unbreakable container that can be produced at low cost—*quickly.*

Amos Molded Plastics is turning out these little "pillboxes" by the millions—another example of the efficiency and speed with which even the tiniest parts or products are produced by Amos Injection Molding. The plastic canteen also is molded by Amos.

Now is the time to redesign parts and products to take advantage of low costs, rapid production in plastics. Amos engineers will aid you in your plastic product development. Write today for helpful, informative booklet "Will You Use Plastics?"—a valuable source of general and technical data on molded plastics.

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA
Division of Amos-Thompson Corporation

Amos
MOLDED PLASTICS...
Custom Molders of Parts and Products by the Injection Process

"OK, that's settled . . . we'll always use AMERICAN PHILLIPS SCREWS . . . THEY'RE FASTER . . . SAFER . . . COST LESS TO USE"

The "get-it-done-or-else" demands of wartime have brought thousands of production men to see plainly the value of American Phillips Screws:

Speed of assembly often doubled . . . because there are no fumbled starts, or crooked screws to back out and re-drive. Spiral and power drivers are made practical, and the 4-winged bit aligns itself in the tapered recess of the screw head . . . drives automatically straight.

Greater safety . . . both for workers and their work. Driver can't twist out to gash hands, spoil work by gouging or puncturing, or leave any snagging burrs on screw heads.

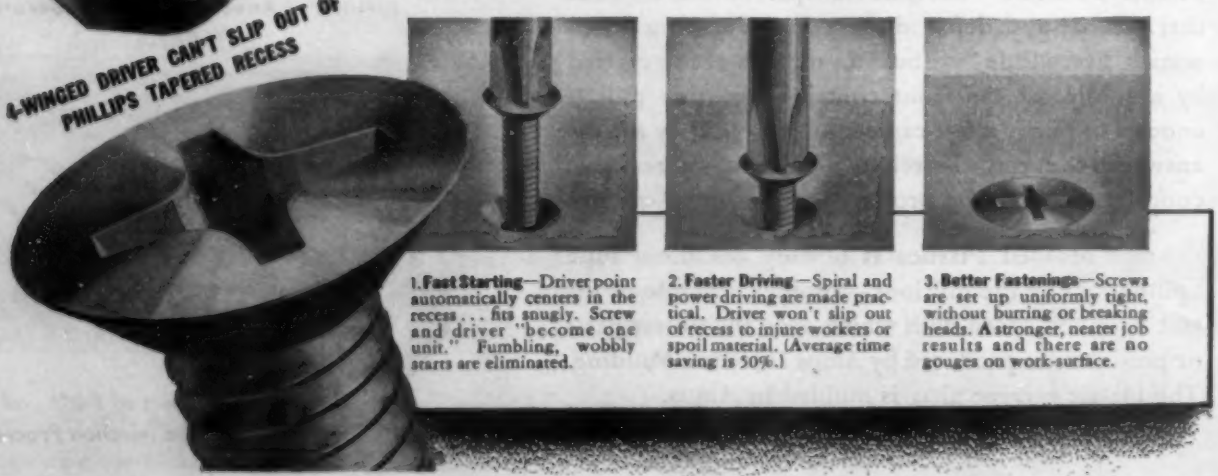
Lower cost . . . savings of 50% in assembly time are not unusual with American Phillips Screws. Production is increased . . . workers are trained in less time . . . spoiled work and lost-time accidents are eliminated. Uniformly high quality is assured by American's constant research in materials and methods, and by individual inspection of screw head, thread, and point.

Now add the final extras of American delivery service and engineering assistance on special fastening problems . . . then you *know* why everyone who ever tried American Phillips Screws is using them today . . . *and why those who have come to use them in time of war will continue to use them in time of peace.*

AMERICAN SCREW COMPANY
PROVIDENCE, RHODE ISLAND

Chicago: 589 E. Illinois Street — *Detroit:* 502 Stephenson Building

4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS



1. **Fast Starting**—Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

2. **Faster Driving**—Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

3. **Better Fastenings**—Screws are set up uniformly tight, without burring or breaking heads. A stronger, neater job results and there are no gouges on work-surface.

NORTON LABORATORIES (INCORPORATED)

CUSTOM MOULDERS OF SYNTHETIC PLASTICS

BAKELITE DUREZ

LOCKPORT, N.Y.

NORLOC NOVELTIES

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL. CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER

March, 1944

Dear Readers:-

I'm the fellow who sees that the finishing of all plastics leaving this plant are acceptable. Hello!

We are up here in a great fruit country, not too far from the soil, where we can see the apple blossoms in spring, and the snowy frozen fields in the winter.

We can follow natures' own production line throughout the year, from the first bud to the full-blown fruit. And, believe it or not, we often get good production thoughts from watching the cycle of growth and fruition.

Some people are kind enough to say Norton turns out the best finished pieces in the industry, often a half million in a single day. We are not perfect, but we are darn good, and we're proud of what we accomplish.

If you'd like some thinking done on your molding problems up here from our "country point of view", drop us a line.

Very truly yours,

Cecil Clack

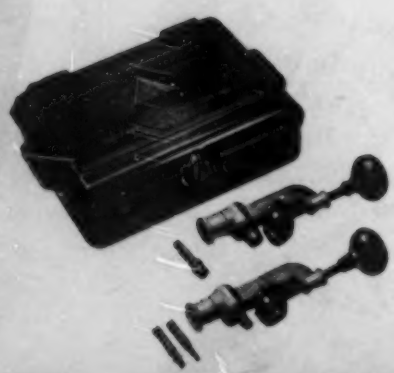
Cecil Clack
Finishing Superintendent

• Courtesy The Parker Appliance Co.

NO MARGIN FOR ERROR

Aeronautical specifications allow no margin for error — especially when it comes to providing tools for aircraft. When The Parker Appliance Company needed a case for their beading tool kit, they asked Watertown engineers to mold a sturdy box whose every cavity and ridge would conform to rigid specifications.

This handsome case is molded from a special material — Neillite Formula 60-100 (medium high impact) — compounded at Watertown. It was molded in dies designed and made by Watertown engineers and polished, buffed, and assembled in our own plant.



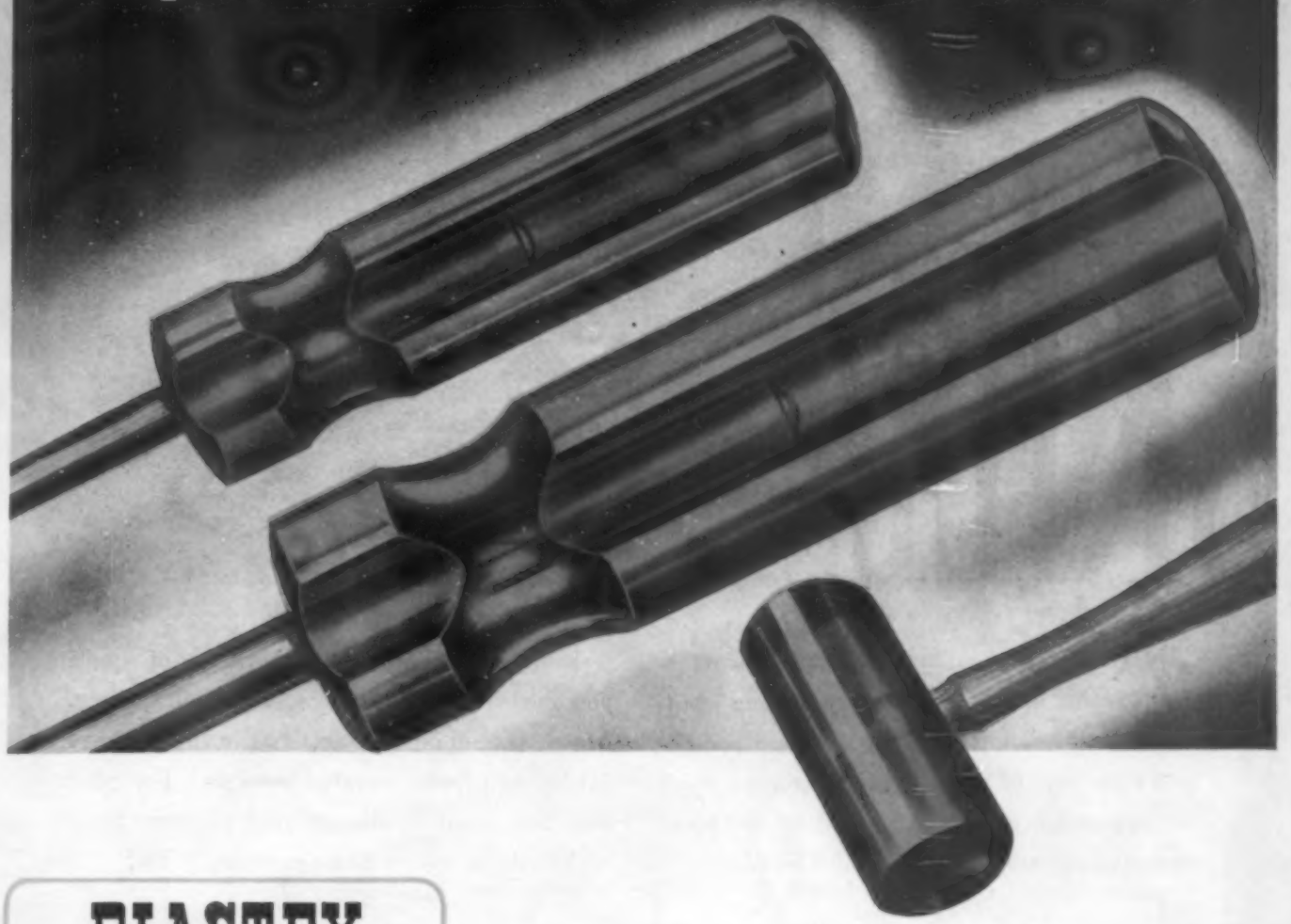
We are glad to place our 29 years of experience in plastics at your service, to assist you in specifying formulae and designing and molding shapes to suit your specifications.

THE WATERTOWN MANUFACTURING COMPANY
WATERTOWN, CONNECTICUT
Branch Offices in Chicago • Cleveland • Detroit • New York City

Watertown
A NAME AS OLD AS THE PLASTICS INDUSTRY

PLASTEX

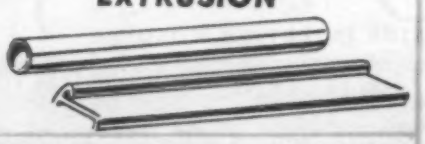
Helps Make War Production Miracles



PLASTEX

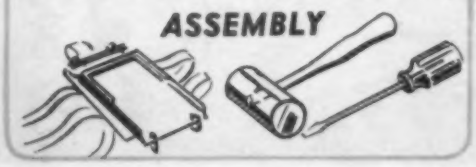
offers immediate production on

EXTRUSION



FABRICATION

ASSEMBLY



From tools to tubes . . . and from simple stampings to complex assemblies . . . Plastex is helping create wartime production miracles. We can't talk about most of the things we are making today but the tools illustrated here are examples of our ability to engineer, fabricate, extrude or assemble. Plastex offers one of the largest capacities for production and assembly of all types of thermosetting and thermoplastic materials. If yours is a problem of production for war or of planning for peace, *contact us today.*

• PLASTEX •

THE PLASTEX CORP. • COLUMBUS, OHIO

SKILL

THE superior skill of American pilots is winning air battles on every fighting front. In the same sense, it's the superior skill and the long experience of Sinko Plastic Engineers which are responsible for the extraordinary success of so many intricate Sinko Injection Moldings.

Sinko has been making better tools and dies for 25 years . . . and better injection moldings ever since thermoplastics were introduced. Small wonder we've developed superior methods and techniques, an unsurpassed knowledge of simple and intricate steel reinforced injection molding. Many peacetime products we've made have helped to capture coveted markets. For your own best interests, discuss your post-war plans and products with a Sinko engineer, NOW!

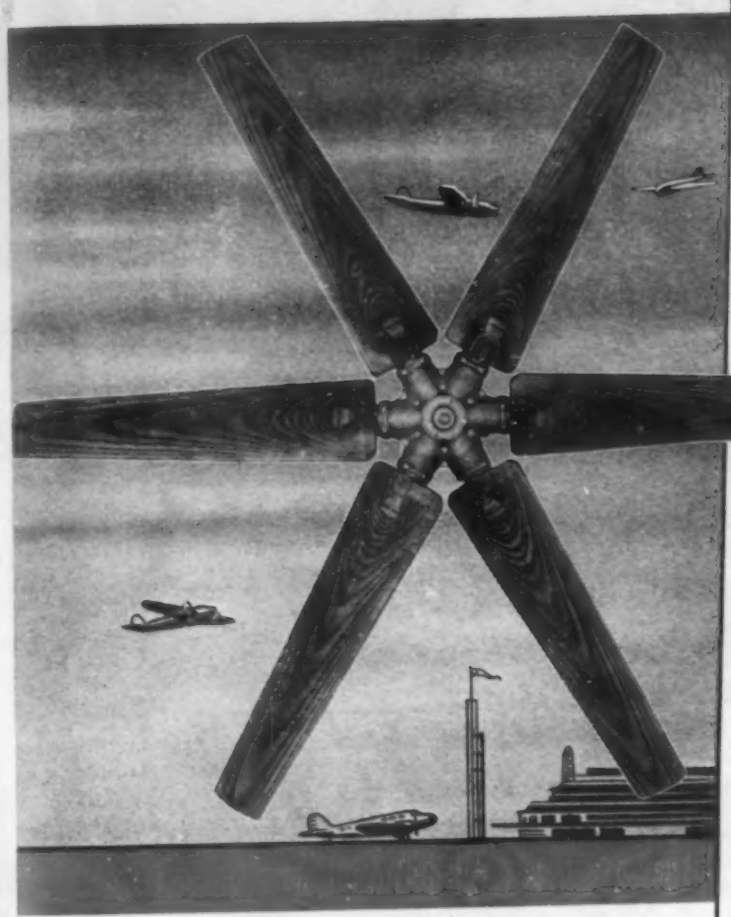
Sinko

PRECISION INJECTION MOLDING

SINKO TOOL & MANUFACTURING COMPANY, 351 NO. CRAWFORD AVENUE, CHICAGO, ILLINOIS

REPRESENTATIVES: L. D. MOORE, 4030 CHOUTEAU AVE., ST. LOUIS, MO. • POTTER & DUGAN, INC., 29 WILKESON ST., BUFFALO, N.Y. • ARCH MASON, 259 CENTRAL AVE., ROCHESTER, N.Y. H. O. ANDERSON, 202 HERALD BLDG., SYRACUSE, N.Y. • PAUL SEILER, 7779 CORTLAND AVE., DETROIT, MICH. • QUEISSER BROS., 108 EAST NINTH ST., INDIANAPOLIS, IND.

TOUGHEST TEST for LIQUID RESINS...



C. P. C. SPECIFICATION RESIN plus CAMFIELD PROCESS—First to Meet Rigid Army-Navy Requirements for Molded Compregwood

HERE WAS THE PROBLEM confronting Camfield Manufacturing Company: To so plasticize wood that it could be compressed to extreme high density, thus imparting strength far greater than that of ordinary plywood. To completely fortify it against appreciable change in dimension or absorption of moisture. Then... to produce these characteristics *in the high degree* called for in Army-Navy specifications.

SUCCESS DEPENDED on two things: (1) perfection of an improved compression process; (2) a resin precisely adjusted to the *unique* functional and production requirements of the job.

AFTER MONTHS of research and experiment, after testing many competitive resins, Camfield perfected the process, and—C. P. C. developed the successful resin. Then C. P. C. so stabilized production of the resin that *the performance of every shipment delivered has been identical* with the first.

Now Camfield, the nation's major supplier of these vital test propellers, uses C. P. C. impregnating resins exclusively.

DO YOU HAVE A RESIN PROBLEM?

LEADING INDUSTRIAL CONCERNS COME TO C.P.C. for solutions to challenging resin problems. C. P. C. service is distinguished by a genuine willingness on the part of its engineers to develop new resins *exactly* suited to individual requirements of specific applications. *Your* problem interests C. P. C. Write Central Process Corporation, 1401 Circle Avenue, Forest Park, Illinois.

CPC

CENTRAL PROCESS CORPORATION

SIMONDS SAWS speed plastic-cutting in PAN AMERICAN AIRWAYS' new Miami maintenance building

To service the fleet Clippers that link the continents, Pan American World Airways System has completed its largest maintenance building, covering 2½ acres west of the Miami passenger terminal.

Here, where 12 to 18 planes can be serviced at one time, speed is vital on all work. So Simonds Circular Saws are used on many operations like the one shown . . . in which a 10" high speed saw is cutting sheet plastic which goes into everything from radio dials to cabin windows.

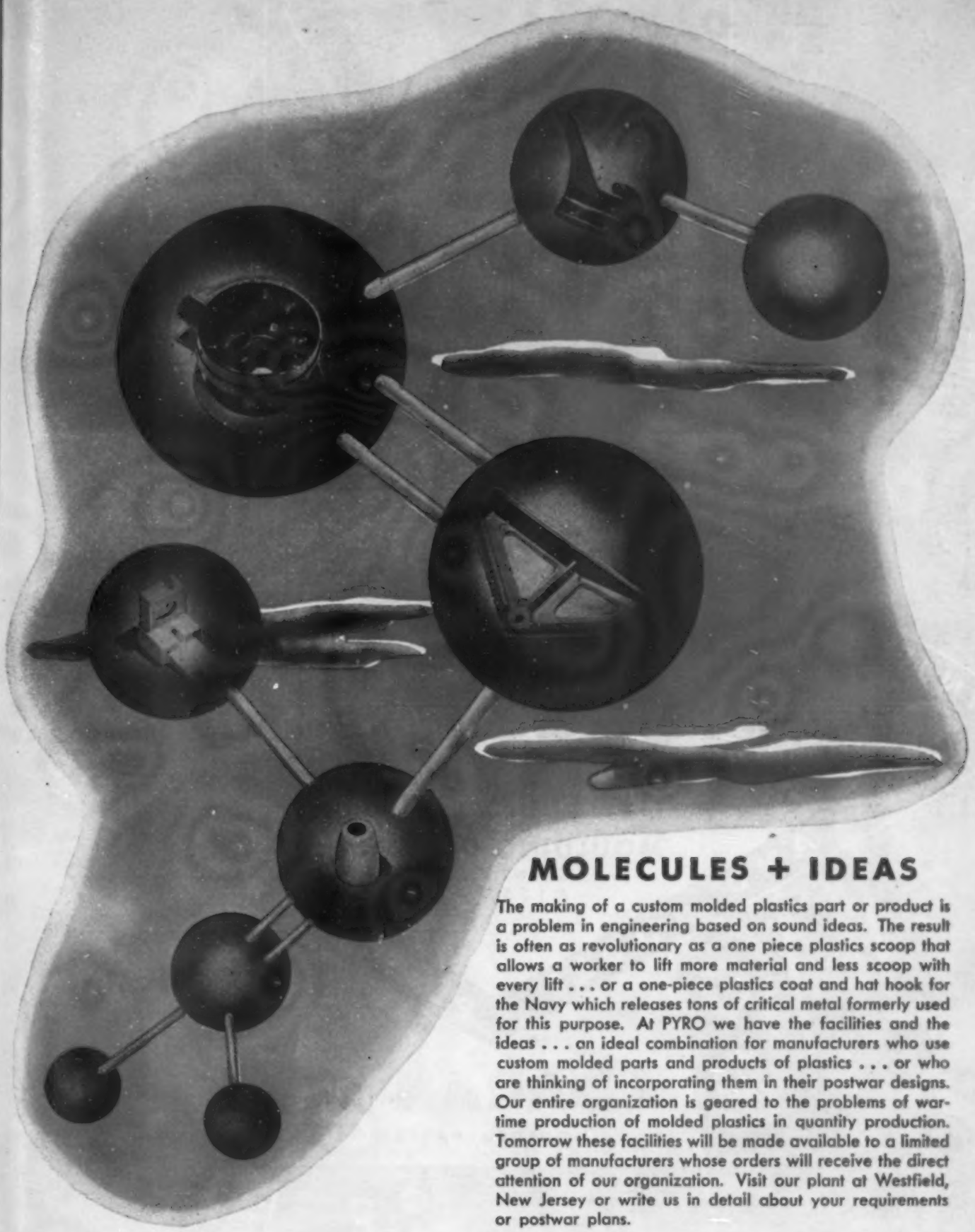
America's most experienced saw-makers produce tools to cut plastics of all types . . . and to cut them faster, smoother, straighter, with longer operating intervals between grinds. Have your Industrial Supply Distributor bring a Simonds engineer to take a quick, first-hand look at your cutting operations *{no long-drawn-out paper survey}* . . . and see what he can do to help you increase production and increase the life of your cutting tools. Get in touch with your dealer *today.*

SHORTEN THE WAR **BUY BONDS!**

BRANCH OFFICES
1350 Columbia Road, Boston—27, Mass.; 127 S. Green St., Chicago—7, Ill.; 228 First Ave., San Francisco—5, Calif.; 311 S. W. First Ave., Portland—4, Ore.; 520 First Ave. So., Seattle—4, Wn.; 31 W. Trent Ave., Spokane—8, Wn.

SIMONDS
SAW AND STEEL COMPANY
FITCHBURG, MASSACHUSETTS

PRODUCTION TOOLS FOR CUTTING METAL, WOOD, PAPER, PLASTICS



MOLECULES + IDEAS

The making of a custom molded plastics part or product is a problem in engineering based on sound ideas. The result is often as revolutionary as a one piece plastics scoop that allows a worker to lift more material and less scoop with every lift . . . or a one-piece plastics coat and hat hook for the Navy which releases tons of critical metal formerly used for this purpose. At PYRO we have the facilities and the ideas . . . an ideal combination for manufacturers who use custom molded parts and products of plastics . . . or who are thinking of incorporating them in their postwar designs. Our entire organization is geared to the problems of wartime production of molded plastics in quantity production. Tomorrow these facilities will be made available to a limited group of manufacturers whose orders will receive the direct attention of our organization. Visit our plant at Westfield, New Jersey or write us in detail about your requirements or postwar plans.

THE PYRO PLASTICS COMPANY

WESTFIELD • NEW JERSEY

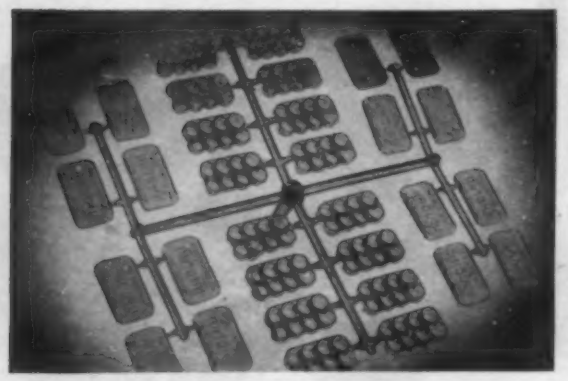
INJECTION MOULDING
EXTRUSION MOULDING
PLASTICS
St. Louis
Plastic Parts of Every Description
ST. LOUIS PLASTIC
MOULDING COMPANY
SAINT LOUIS
MISSOURI
DIES AND TOOLS
PLASTIC FABRICATION
PIPE SARAN TUBING
MOULDED PARTS

How's this for a postwar "pill" box . . . and an example of FIBESTOS' versatility?

This small box of transparent Fibestos, so tough that you could stamp on it without crushing it, may very possibly point the way to a big, new postwar market for more than one alert custom molder.

At the very least, it illustrates anew the particular virtues of one of the oldest of modern plastics—cellulose acetate.

The box was designed for the Army Medical Corps to carry the sulfadiazine tablets with which soldiers going into action are supplied. The tablets are held securely in eight round depressions molded in the base of the box. The lid fits snugly yet slides open so easily that a wounded man could open it with his teeth if necessary.



The boxes are being injection molded, sixteen complete boxes at a time, by the St. Louis Plastics Molding Company for the Upjohn Company of Kalamazoo. A Fibestos cellulose acetate compound of medium high acetyl content was selected for the job, first, because it was essential to have good moisture resistance and dimensional stability for the proper fit of lid to base.

Of equal importance in the selection of the correct Fibestos compound for this job, however, was the fact that with the medium high acetyl

material selected, it has been possible to attain the unusually rapid molding cycle of twenty seconds. Other contributing factors: good flexural, compressive and impact strength, relatively high heat distortion point and adequate surface hardness.

As any experienced molder well knows, selection of the best possible material for a particular job often determines the success or failure of the job. That's why it pays to have available the knowledge and experience of Monsanto plastics consultants on any big job . . . To get their help on *your* jobs, write Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts.

The broad and versatile family of Monsanto Plastics includes: Lustron polystyrenes • Saflex vinyl acetals • Nitron cellulose nitrates • Fibestos cellulose acetates • Opalon cast phenolics • Resinox phenolic compounds Resimene melamine compounds. Forms in which they are supplied include: sheets • rods • tubes • molding compounds • castings • industrial resins coating compounds • Vuepak rigid, transparent packaging materials.

MONSANTO
PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

YOU MAY FIND YOUR PREWAR LINE

"She ain't what she used to be"!

Yes, when the smoke of war blows away for good and you take a look at those products of yours that used to "lead the market," you may be shocked at their lack of snap and sparkle. Something may be lacking, and that "something" can well be *plastics*. So as not to suffer by comparison on the counters and in the show cases and display windows of the country, thousands of once very smart items are right now receiving a thorough going over by manufacturers.

To a large extent, this is a plastic-equipped war. From complete plane cowls to simple instrument handles, an unbelievable number of fitments are wholly or partially of plastics. Men in service have gotten used to the fine "feel," pleasing colors and sturdy wearing qualities of this modern material. Once back in civil life, they will most certainly favor products of plastic — and wise is the manufacturer who plans for this now.

Although the facilities of Waterbury Companies, Inc., are going full time on war work, we have a department that will gladly help you to PLAN WITH PLASTICS. It includes these activities:

DESIGNING—If you are unfamiliar with the mechanical properties of modern plastics, our designers may suggest how not only to produce your product in plastics but also to improve it.

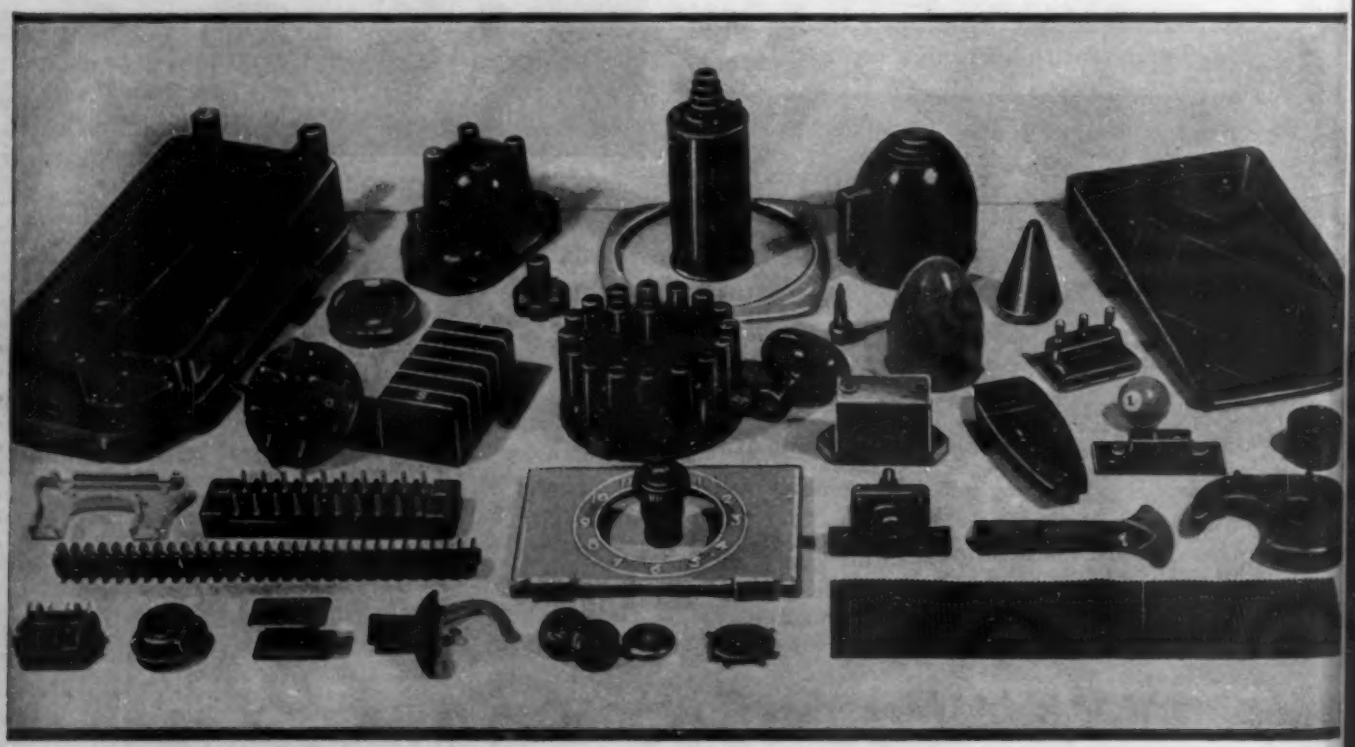
MOLD MAKING—A good plastic begins with a good mold. If you are not equipped with molds, we will provide them and back their performance.

MOLDING—This service includes compression, transfer and injection molding, done on improved machines operated by veteran molders. Choose any plastic.

ASSEMBLING—Where assembling can not be done in the molding machine, our skilled assemblers can do it afterwards—usually to better advantage than it can be handled in the average plant.

WE STILL WANT WAR WORK!

The war is by no means over, so please consult with us on your war needs.



PLAN WITH PLASTICS

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WATERBURY COMPANIES, Inc.

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WATERBURY, CONN., U.S.A.

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Our experiences in co-operating with several laminators have strengthened our faith in our policy of working closely with each individual company toward the development of impregnating papers to meet individual, specific needs. When one considers how unlikely it is for any two laminators to handle even the same resin exactly alike or to follow exactly the same procedure in their processing or in their development of new products, doesn't the application of individual impregnating papers make sense?

MUNISING is willing and eager to submit sample rolls of impregnating papers - not with the thought that these initial sample rolls are going to solve a problem, but with the feeling that experimental work with these rolls may bring to light clues which may be helpful in determining further procedure toward the manufacture of individual impregnating paper for you.

The services of our experienced technical staff, our background of precision-made pulp and paper manufacture, and our willingness to co-operate in the development of individual impregnating papers to suit your specific needs are available to you.

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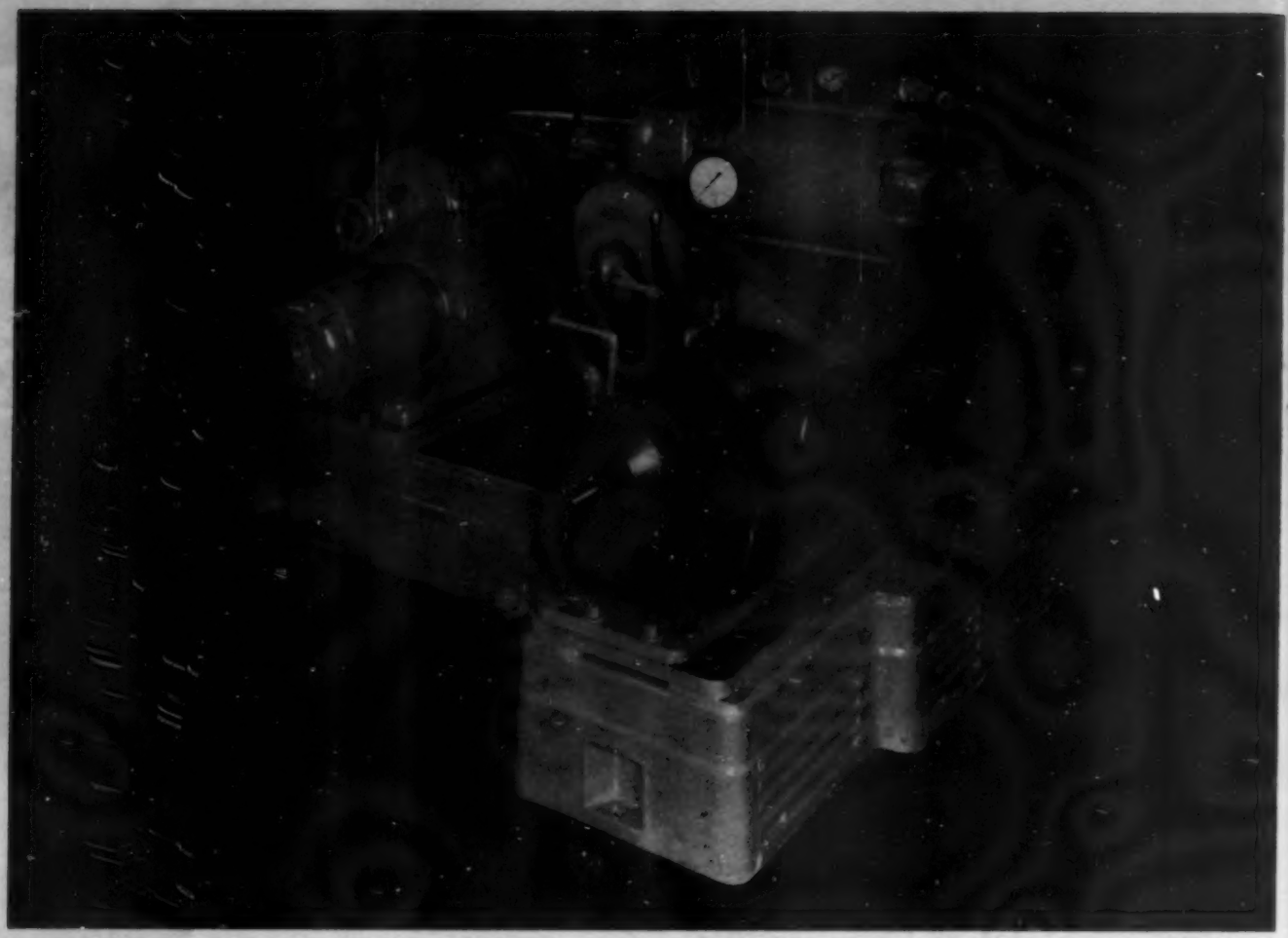

"COMMUNICATIONS HOLD THE OFFENSIVE TOGETHER . . ."

Troops concentrated. . . . suppplies brought up. . . . the zero hour approaches. The signal is given and the carefully planned offensive is under way.

Whether it is storming a height, establishing a beach head or a tank assault the success of the operation may well depend upon the maintenance of communications. And communications depend upon wire.

Today Royle equipment is playing an important part in meeting the demands for plastics insulated wire that can "take it". . . . whether the icy blasts of the frozen north or the sweltering, sticky heat of the tropics.

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How to Maintain a Constant Power Supply for HYDRAULIC EQUIPMENT That will "Step-up" Production and Lower Costs

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Patented. Modern, efficient, reliable . . . requires minimum floor space, no special foundation. Foolproof design and construction give a constant flow of power, always.

THE Elmes pistonless-type, air-ballasted accumulator is today's most efficient method of storing liquid under pressure; and, within specific predetermined pressure limits, it gives a constant power supply. The effectiveness of this unit is the result of over 50 years' experience in the design and construction of accumulators. As a result, Elmes installations in scores of the leading plants of the U. S. and Canada are today rendering uninterrupted service. These are the advantages an Elmes air-ballasted accumulator will bring to you:

ELIMINATES LINE SHOCKS! The compressed air, used to maintain pressure on the column of liquid, serves as a shock absorber and thus eliminates line shocks.

CLOSER PRESSURE REGULATION! The pressure variation from the high to low point of the liquid column is definitely controllable by the volume in the air chamber.

SAVES FLOOR SPACE! Because pressure vessels are not large in diameter and since no large ballast tank or platform is required, there is a definite saving in floor space.

NO INTERNAL MOVING PARTS OR PACKINGS! There are no pistons or internal moving parts to be maintained because compressed air acts directly on the column of liquid.

EASY TO INSTALL! Elmes air-ballasted accumulator requires no special, heavy foundation. Pressure vessel, or vessels, are quickly and easily set in place on the ordinary factory floor.

VARIABLE PRESSURE ACCUMULATORS are also available with pressure changes attained by simple fingertip controls.

Consult the Elmes Engineering Staff for a solution to any hydraulic power problem with which you are confronted. Or, write for a FREE copy of this late bulletin on accumulators. It describes their design, construction, safety features, electrical controls, etc.

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Molders of Plastics and Hard Rubber
Established 1897
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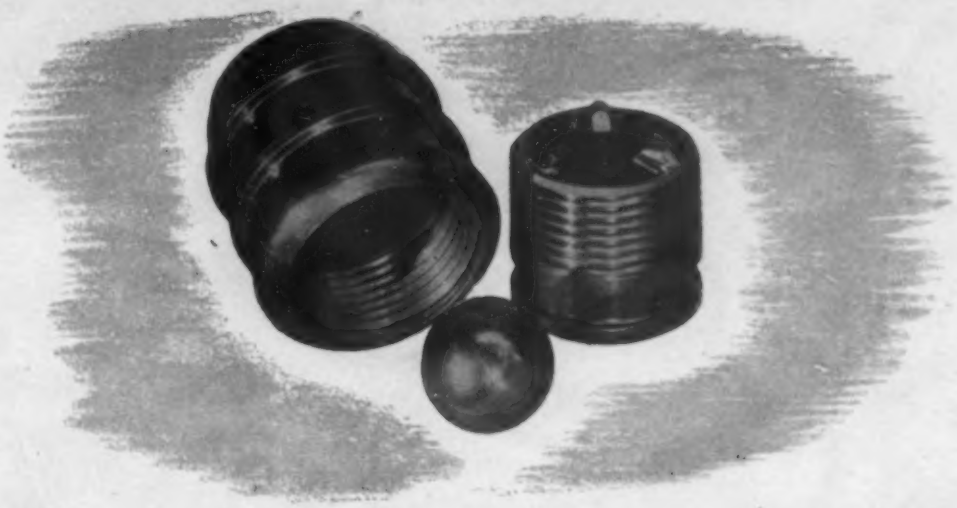
BAKELITE

TRADE MARK



What is meant by "HIGH MECHANICAL STRENGTH"?

Over a period of fifteen years, these BAKELITE impact-resistant plastic parts have been used on the guiding and valve mechanisms of oil-well drilling equipment because they have provided the high mechanical strength required for such heavy duty. In this instance, "high mechanical strength" meant the best combination of compressive and impact strengths consistent with best fabricating technique and mold design.

This is typical of the parts that may be successfully produced from BAKELITE Plastics when their properties and limitations are fully understood. To further that understanding, Bakelite Corporation is publishing a series of booklets, the first of which discusses plastics in terms of mechanical strength, dealing with such factors as compressive and impact strengths, tensile and flexural strengths, toughness, or resistance to mechanical fatigue.

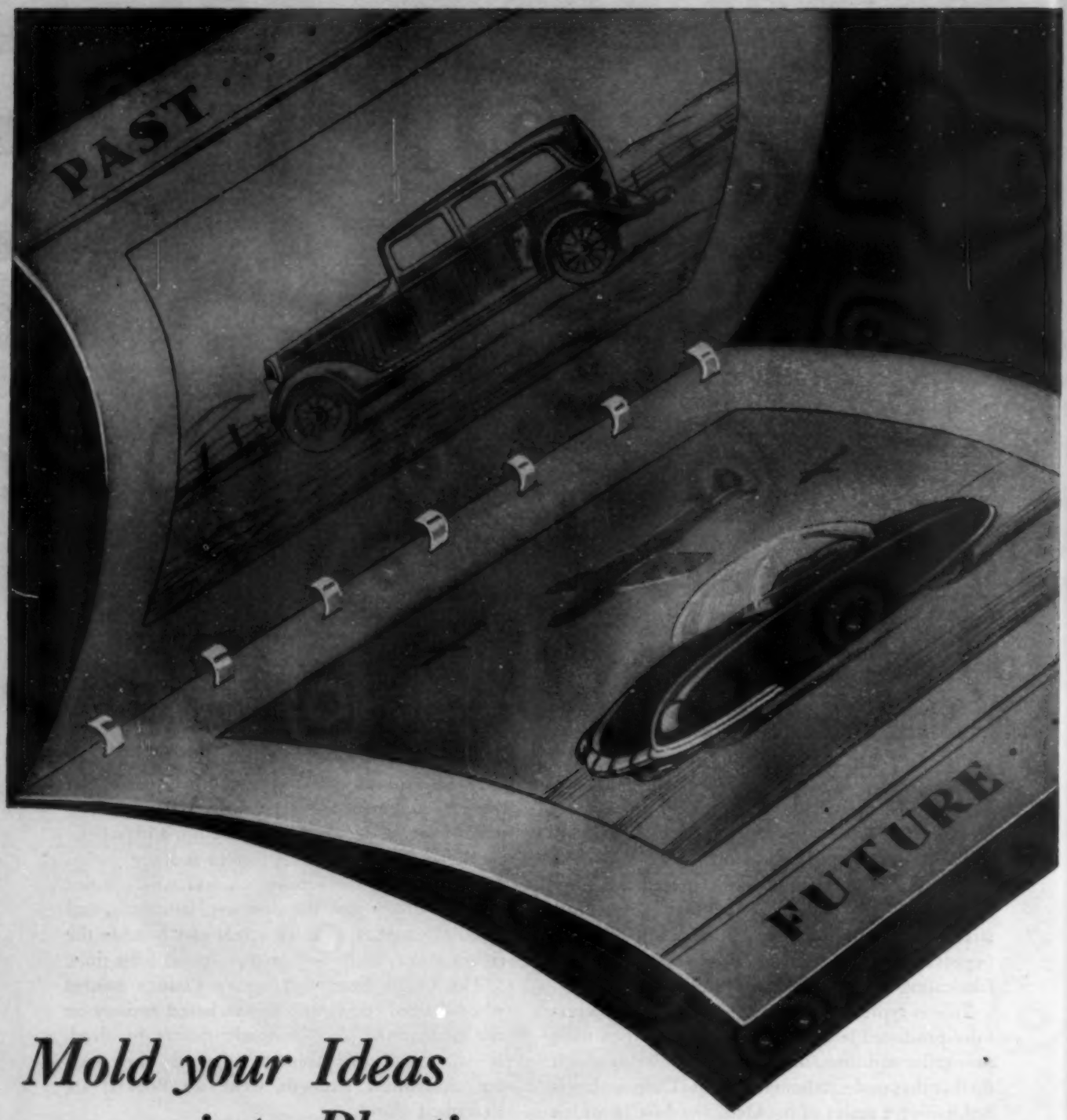
No one plastic can register "high" in all of these requirements. That is why every new use merits careful study of all operating and service conditions, and such cost factors as mold design and fabricating techniques . . . and why plastics users should regard the designer, fabricator, and material supplier as a team that can provide the right answer, at the lowest cost, in the least time.

The broad line of BAKELITE Plastics assures you unbiased recommendations, based entirely on the engineering and economic factors involved. If your plastics problem suggests the need for mechanical strength, write for Booklet 15, described above.

BAKELITE CORPORATION, 30 E. 42 St., New York 17

Unit of Union Carbide and Carbon Corporation

Laminating Plastics



Mold your Ideas into Plastics

From first idea, all the way through design, molds and complete finish, the twenty-two years experienced Reynolds organization will expertly engineer your plastic problems . . . today . . . tomorrow.

Plastics fabrication by compression, injection, extrusion, sheet forming.

★

LET'S ALL BACK THE ATTACK
BUY WAR BONDS

REYNOLDS MOLDED PLASTICS

CAMBRIDGE, OHIO

SALES OFFICES IN ALL PRINCIPAL CITIES

DIVISION OF REYNOLDS SPRING CO.

JACKSON MICHIGAN

WILL THIS

VACANT CHAIR

COST YOU MONEY AND MARKETS?

If the "paper technician's chair" remains vacant during your conferences on present or postwar production plans, you may be passing up economies and improvements vital to the future progress of your business.

Mosinee Paper Technicians have met many of the demands of war service by developing "special analysis" industrial papers, with properties never before considered possible in paper. Today, industrial papers have broader utility . . . and will have still more in postwar use.

Paper specially engineered by The Mills of Mosinee to meet your exact needs, may speed up processing, assembly or packaging operations . . . replace critical materials, lower your costs, multiply your markets.

Call for a Mosinee Paper Technician to fill that "vacant chair." The broad experience and facilities of the Mills of Mosinee are ready now to go to work on problems of present or postwar product planning and production.

Please address your letter "Attention Dept A"

MOSINEE PAPER MILLS COMPANY
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Essential Paper Makers

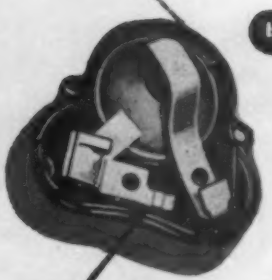
INJECTION *Molding*

Until war brought restrictions, we were injection molding this popular Ristlite of cellulose acetate in five different colors at the rate of 200,000 per month—and had already passed the two million mark. The intricately designed multiple cavity, completely automatic mold which stood up to this production without showing any sign of wear, was a Sterling-built achievement. Its unique construction ironed out many a bug—enabled two complete cases to be molded at a time and brought about a cost for the item that was low by every manner of comparison. . . .

ⓐ . . . Ristlite as removed from the mold . . . a pair of bodies, front covers and switches with parts for locking cover to body and for fastening strap to body—all included as a one shot operation.

ⓑ . . . Bosses set out from the covers and on switches enable contact assemblies to be heat-riveted into secured positions. A single cold-spreading operation fastens lens and reflector. The tools for these finishing operations by the manufacturer were Sterling-designed and Sterling-built. . . .

This job, typical of Sterling, prompts us to invite inquiries from those faced with molding problems . . . for today's needs and tomorrow's!



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50 to 3000
Pounds Pressure from your Present Hydraulic Circuits
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RACINE
Hydraulic Pressure BOOSTER

A high pressure, oil hydraulically actuated, compact, self-contained auxiliary to your present low pressure hydraulic circuit. Increases your source of force as much as 7 to 1. Creates new standards of flexibility and operating economy.

FOR NEW OR OLD HYDRAULIC CIRCUITS. Fits anywhere into your present or new hydraulic circuits without interference. Now you can obtain *high pressure when you need it—return to low pressure at will.* Use low horsepower motor and low pressure control valves—results in lower initial investment and reduced operating and maintenance costs.

Can be used in circuits with either variable or constant volume pumps.

Free from repairs — no gears to wear out — no driving mechanism to get out of adjustment. The Racine Hydraulic Pressure Booster is an exclusive patented unit. For complete information ask for illustrated bulletin. Address Dept. MP-P.

"Variable Volume" PUMPS
"Balanced-Piston" VALVES

Include in your hydraulic circuits Racine Oil Hydraulic "Vane Type-Variable Volume" Pumps. Capacities 12 - 20 - 30 G.P.M. Operating pressures 50 to 1,000 pounds per square inch. Racine "Balanced-Piston" Valves insure ease of operation. Sizes ⅜" to 1½". Available with manual, solenoid, pilot and mechanically operated devices. Let Racine engineers help you with your oil hydraulic applications. Ask for Bulletin P-10-C.

Racine "Variable Volume" Oil Hydraulic Pump

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For 36 years Racine has led the field in metal cutting machines. Positive screw feed and the application of hydraulic operation, feed and control to metal cutting machines of the reciprocating type, were first developed by Racine. A full line—capacities 6" x 6" to 20" x 20".

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Standard for Quality and Precision
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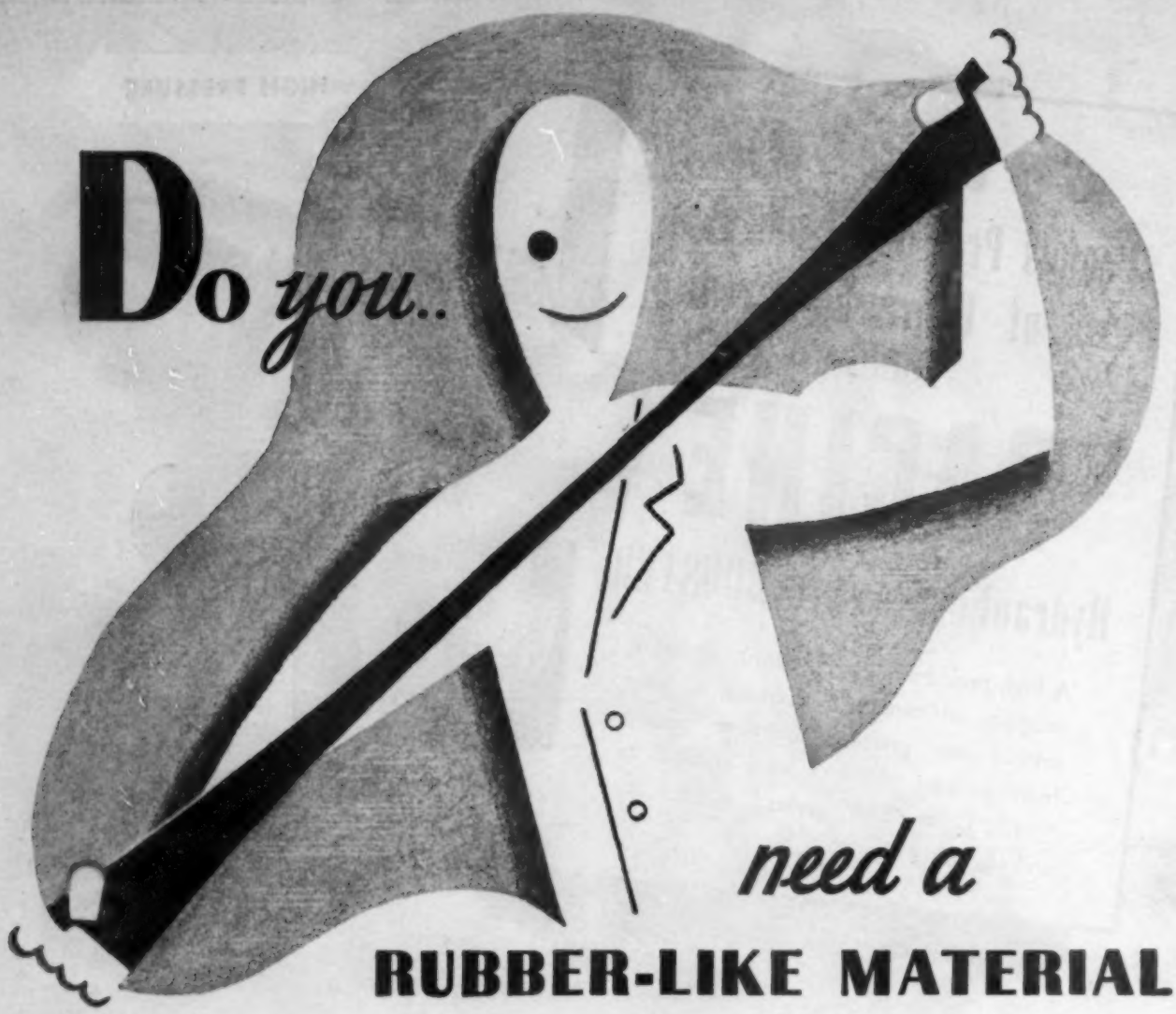

Do you.. need a RUBBER-LIKE MATERIAL?

For manufacturers who dip, coat or impregnate with rubber, or use adhesives or rubber-like materials, and are faced with a shortage of these products, we may develop for you a water-dispersed material to meet your requirements.

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symbolizing research and development in water US *dispersions*

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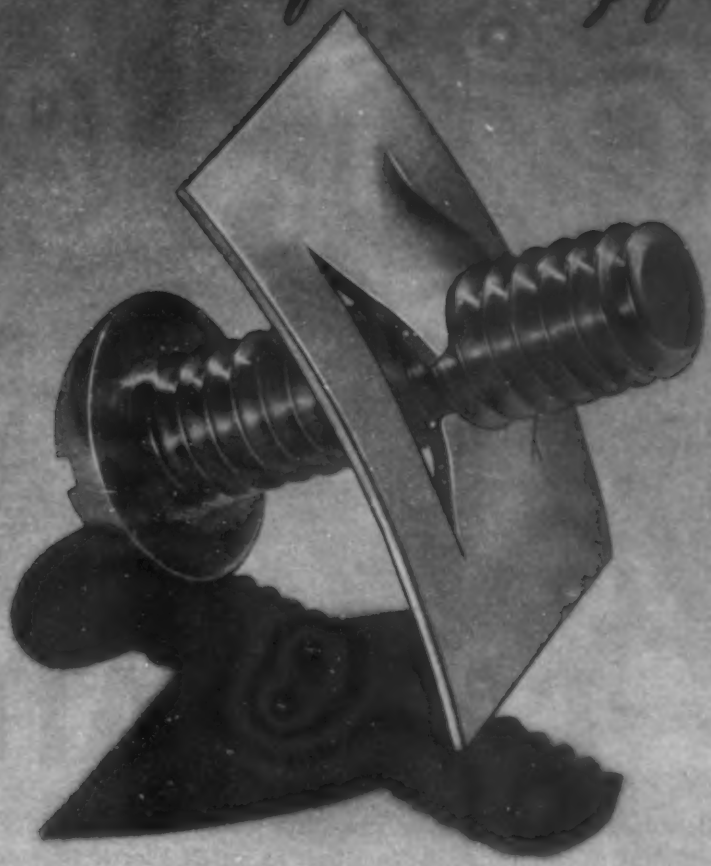
Speed Nuts perform more than a fastening function



They prevent vibration loosening by means of their exclusive Double Spring-Tension Lock that ABSORBS the vibration • They are applied faster and so reduce assembly time and costs, tremendously • They avoid use of wrenches and needless handling of parts • They are even made in scores of ingenious shapes that completely eliminate two or more parts • Their wide bearing surface removes the need for spanner washers • They save from 50% to 80% in weight • If you do not have our 20 page summary catalog No. 185, write for your copy today.

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FASTEST THING IN FASTENINGS..

Beauty CAN WAIT !

Because the word "Plastics" is so often associated with beauty and sales-appeal, we want to emphasize the fact that Riegel-X Plastic Laminates are primarily *functional*. Beauty is important but utility comes first today!

This even goes beyond competition with the ordinary functional uses of other plastics and metals, because Riegel-X Plastic Laminates are distinctly new.

They have been tested, approved and put in use throughout the world in order to meet important technical requirements of our war effort — demands for greater light-weight strength, higher thermal insulation, increased dielectric properties, fire resistance, precise fabrication, and other basic qualities that Riegel-X Laminates possess. Many of your products may need these qualities.

For tomorrow's use, progressive manufacturers are already working with these new functional materials for refrigerators, furniture, pre-fabricated homes, boats, pleasure planes and similar important products.

Many other applications are still awaiting development. Find out now where Riegel-X Plastic Laminates fit into your post-war plans. Riegel Paper Corporation, 342 Madison Avenue, New York 17, N. Y.

RIEGEL-X

x A group of plain and impregnated base papers for both fluid and direct pressure plastic laminates. x

101

When we take on a plastic molding job here at General Industries, we work everlastingly hard to fulfill every commitment. And we have the experience and the facilities to make good on our promises.

Raw plastic material in a barrel is much the same to any molder. It's the way that material is put to work that spells the difference between competence and incompetence. Equipment is important, of course, but it's available in ordinary times to any molder. What isn't so readily obtainable is that intangible ingredient of experience.

One place where that experience is mighty important is in the making of molds. Micrometer tolerances, inserts, thin and thick sections, polished surfaces, openings in several directions . . . all these call for a skill and knowledge that will make the most practical mold for the specific job. That's the kind of experience that isn't gained overnight—that isn't available unless the molder has met and defeated similar problems before.

We have that experience here at General Industries—obtained from molding of plastic parts by the millions—in widely varying shapes, sizes and materials. Naturally, we have the necessary presses to turn out the work according to specifications and schedules.

So, we suggest that when Uncle Sam finishes the important work in hand, and the urgent pressure is off, you bring your plastic problems to General Industries. You'll find here the facilities and the experience which are so important to your product. And you can take it from us, we won't let you down.

THE GENERAL INDUSTRIES COMPANY
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Molded Plastics Division • Elyria, Ohio

Chicago: Phone Central 8431
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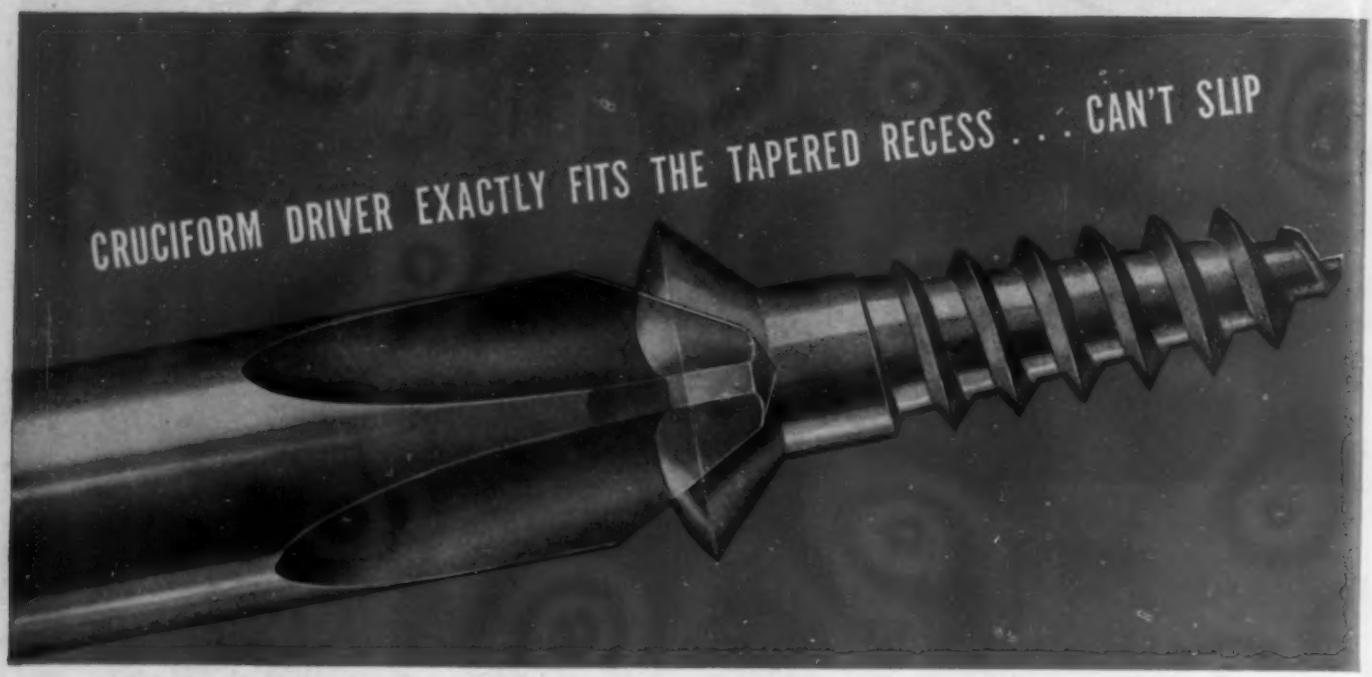
makes the famous Phillips Recessed Head Screws and Bolts, scientifically engineered for fast-starting, faster and easier driving, better fastenings.



7 *distinct advantages of the Phillips Recessed Head*

1. Self-centering on the driver
2. Holds driver from slipping
3. Drives faster
4. Eliminates head breakage
5. Frees operator's hand to hold work
6. Makes better appearance—prevents marring work
7. Simplifies hard-to-get-at jobs.

National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

MODERN PLASTICS

MARCH 1944 VOLUME 21 NUMBER 7

Speak and be heard

by STERLING SEARS*

IN its early development work in connection with communication and control equipment, the Aviometer Corp. foresaw the extensive use of plastics for other reasons than their excellent electrical insulation and mechanical strength properties. One advantage of these materials for wartime military use lies in the fact that a device which looks practical, sturdy and efficient will automatically inspire confidence in its use. An additional factor not previously exploited relates to qualities of certain plastics which can be used to produce greatly enhanced acoustic performance.

Communication accessory products include microphones for the conversion of sound into electrical energy, headphones for the conversion of electrical energy into sound and control members to make practical use of the properties of the two. For many years thermosetting and thermoplastic materials have been used in housings for metal-fabricated communication sub-assemblies and for insulating various members to insure their long reliable, service life without electrical failure.

Additional factors which have been taken into consideration in the manufacture of radio equipment from plastics are the materials external appearance and beauty. However, there has been a difference of opinion among engineers as to the usefulness of plastics where acoustic performance is critical, and their ability to stand up against other acoustic material has been questioned.

Qualities which are particularly desirable in the fabrication of telephone apparatus are durability, retention of size, impact resistance, surface strength, resistance to resonant vibrations, lightness in weight and the ease with which intricate forms can be produced consistently and with great uniformity. In the familiar, widely used telephone apparatus, however, the use of plastics has been limited to housings, mechanical supports and electrical controls. The Aviometer Corp. felt that such limitations based on past experience need not continue, especially in applications where wartime requirements stress the need for economies in number of parts, weight, size and time to manufacture. The products herein described have all been developed with a view to making the greatest use of plastics to achieve reliable performance to close uniformity without sacrifice of any other qualities.

* Vice-president and chief engineer, Aviometer Corp.

This month's cover, a departure from MODERN PLASTICS' customary design, honors the Red Cross, whose current appeal for funds should receive the spontaneous response of every American. Founded for the purpose of ministering to the sick, to the wounded and to prisoners in time of war, this great international organization has steadily widened its activities to embrace the alleviation of human suffering, whatever its source. The plastics industry, which had its beginnings in the decade that saw the birth of the Red Cross, is grateful that its progressive growth has made possible the development of many products which are today used in healing, clothing, feeding and transporting the victims of war and disaster.

Through the Red Cross, Americans have in years of peace helped to relieve the sufferers in epidemic, flood and famine—persons unknown to us. This year our gifts are personal; we are giving to our own men through the great organization which goes with them where we cannot go. This year, above all others, we should sacrifice to give.

Cover photograph by Robert Keene

Headphones

An early development in a new high-fidelity-type head telephone receiver anticipated requirements for simplified electrical connections, uniform extended tone range and high efficiency. Built to do a job which had hitherto been impossible, this unit was developed for use in extremely strong noise fields for the purpose of conveying on the first transmission absolutely intelligible information from remote points in an airplane to a central location. Much depended upon successful transmission regardless of temperature, noise conditions, humidity, altitude and handling of the equipment by unskilled personnel. The application of almost identical equipment to tanks and ships was provided by arranging the simple and flexible components to fit the need. The uniform-response helmet-type headphones have seen extensive use on helmets in aircraft and tanks and more recently in headgear for patrol boats. Out of this design has come the Army-Navy British ANB H-1 headphone which now is standard with the military services.

In this particular unit plastics have provided a simple, uniform and highly durable housing which also serves as an electrical terminal connection for waterproof rubber-covered cordage. Use of this material also makes possible simple interconnection without complicated cords between the head telephones and the rest of the circuit. Figure 2 shows a waterproof, neat and sturdy connection protected from damage and extremely durable. Under service conditions it is almost impossible to pull the communicating cables from the receiver or break the electrical connections. At the same time air pressure relief is afforded so that altitude compensation can be obtained with-

out a lowering of resistance to submersion in water. This same housing provides a uniform and accurate support for the magnet-coil-diaphragm sub-assembly and the unique acoustic-chambered cover which completes the enclosure. This cover (Fig. 3) takes the form of a threaded extension to which a metal-reinforced rubber air cushion, which encloses the ear, can be screwed. When this part is mounted in an aviation or tank helmet, a round hole approximately over the ear is the only requirement for accurately and quickly installing the headphone in the best position for acoustic performance and the exclusion of external noise. The use of thin sections of plastic in the cord grip (Fig. 2), accurately molded threads on which the cap is screwed, and a uniform, strong, vibration-resistant seat for the mounting of the vibrating element sub-assembly, has made a unit that stands up under extensive and abusive service in the field.

Other designs of this unit have incorporated further exploitation of the acoustic cavities for the improvement of frequency response. They have demonstrated that production of these units can be economical and the spoilage small, even when electric and acoustic performance is held within extremely close limits. Company specifications for this type of equipment allow for variations in efficiency and in uniformity of response of ± 1 decibel from production standards. This is considerably closer than military specifications require. However these tolerances seem warranted in view of the fact that confidence in the absolute interchangeability of equipment and reliability under service conditions seems to permit personnel to concentrate completely on the combat mission.

1

Original mold designs were kept as simple as was consistent with the ultimate object. The factors of warpage of the plastic parts after ejection from the mold and of variation in shrinkage of materials through various shipments of molding compounds and through the molding process were overcome by refinement of the molds to bring sizes and shapes into the middle of the acceptable tolerance range. Control of certain dimensions—once considered to be impossible—has proved practical through the expedient of designing the parts for close conformity only where close tolerances are necessary. Since production drawings showed acceptable tolerance over the maximum range that was permissible without alteration in the value of the piece, the mold builder and molder were given greater freedom in their work. In some cases tolerances of

2

3

1—This recently developed lip-type microphone is much smaller than the standard Navy T-38 microphone and has even closer tolerances. **2**—*The inner design of the plastic cord grip which is here disassembled from the earphone housing, gives the part a positive grip on the cord.* **3**—*The 2-part design of the earphone housing assures a neat, sturdy and waterproof connection.* **4**—*The polyvinyl spacer and seal which is used on this part increases the fidelity of the high-frequency receiver*

4

5

±.001 have been held at points of mechanical clamping and acoustical control by a simple machining operation. In recent molds this has been achieved by very careful mold construction. Diameters of small holes which are also involved in the acoustical result have been molded-in to tolerances of .001. The degree of distortion in parts has been held so low as to meet requirements for uniformity of performance with rejections for all causes less than 5 percent. These close tolerances were specified only at the two or three places which are seriously involved in the performance of the unit, and limits of ±.002 or ±.003 have been used only where fits between metals and plastics were important. Tolerances of ±.005 and .008 have been used for external contours, radii, areas which represent clearance where fits were not involved.

5—A simple-easy-acting control button with a recessed thumb grip at the top is employed on the standard Navy carbon-type hand microphone. 6—A cut-away section of a microphone case. Arrows indicate the plunger seal. 7—Another view of the standard Navy microphone showing the switch construction. 8—This pistol-grip-type 3-way switch has corrugations at the side to prevent the part from slipping from the operator's hand. The 2 views (left) show the internal construction of the switch

8

The receiver cover in this unit is compression molded in a 4-cavity die while the receiver cup is produced in a 2-cavity hand mold with threaded rings. The cup mold is purposely limited to a small size in order to control dimensions and meet close tolerances. It is essential that the parts of the receiver cover fit the cup accurately—with the anchorage holes lined up properly.

The receiver caps are molded of black or brown phenolic material in 4-cavity dies. The difference in shrinkage of various molding compounds had to be determined in order to secure uniformity of the fit on the shells. The threaded plugs for this mold were very precisely ground to make sure they were all exactly the same. Careful handling of this hand mold is essential since any little bump on a molded part caused by scratches or dents in cavities or plugs changes the characteristics of the receiver.

Microphones

Design of high-fidelity type microphones is influenced by the very same factors as is the headphone design and has been carried out with similar care. The hand microphone shown in Fig. 5 is of a simple and sturdy design incorporating features of durability, reliability and high-fidelity performance to an outstanding degree. These units have taken tremendous abuse and continue to give uniformly reliable service. Not only will they stand submersion in salt water and service in temperatures from −70 to +150° F., but they are capable of great acoustic and electrical overload without alteration in performance. The combination of metals and plastics in this unit which makes this perform- (*Please turn to page 174*)

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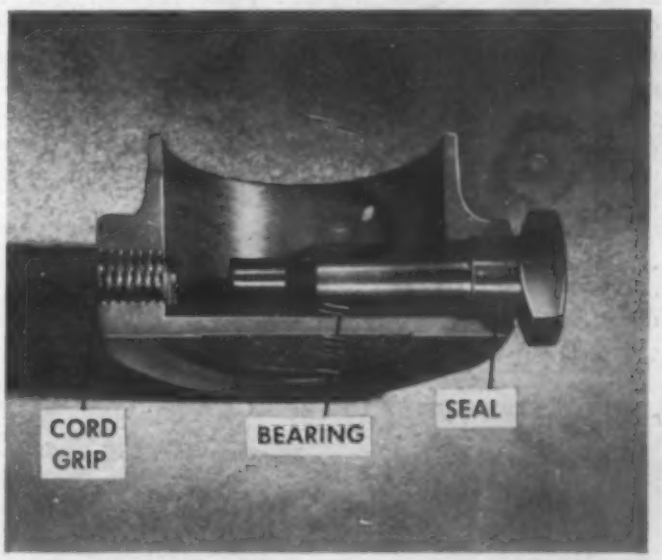

7

Transparent knife-blade fuze

NOT only the power but also the safety of our warships depend in no small measure upon the never failing operation of their guns. These guns, in turn, depend upon electrically actuated, fire-control mechanism. As a result, when a fuze blows out in a ship's power plant, the vessel is defenseless until the damaged fuze is replaced. When conventional fibercase fuzes are used, this repair work can be long and dangerous. Testing lights must first detect which fuze is damaged. Then the blown fuze must be removed Since the fiber casings are tipped with metal there is only a very small space on the surface which is insulated, and wood or fiber pliers must be employed if the part is to be removed without danger to the operator. Many of these difficulties are overcome in a new knife-blade fuze now used by the Navy, which is molded of cellulose acetobutyrate. The transparency of the part enables the operator to tell at a glance which fuze has been blown. In addition, since the entire length of the piece is of non-conducting plastic material with no metal end caps, danger of an operator receiving a shock if he should neglect to use the standard insulated tools, is materially reduced.

In the early spring of 1943 it became evident that replacements would have to be found for critical materials then used in the manufacture of electric fuzes. Many kinds and types of plastics were tried. Some were discarded because of cost per pound of the raw material. Some which had excellent electrical properties were eliminated because of chemical or physical characteristics which prohibited their adoption. And some plastics were too critical to be considered for production use at that time. Finally, clear cellulose acetobutyrate was selected for the molding of the parts.

The knife-blade fuze which is molded in two sizes differs from the standard fuze construction in that the case is made of 2 halves split longitudinally and cemented together. Thus only 2 parts are needed to form a complete case whereas the conventional type fuze requires a fiber case, 2 metal caps, 2 fiber or asbestos washers, from 4 to 6 screws to hold the caps in place, and a steel washer or some other mechanical device for securely locking the 2 copper knife blades in place inside the casing. In addition, the fiber case usually is loaded with some insulating material such as chalk in one form or another or Dolomite. Instead of these 12 to 14 parts which go to make up the conventional fuze, the new plastic unit has only 5 parts—2 knife blades, the fuze link and the 2 plastic fuze body halves. In view of the discrepancy in the number of parts, it is obvious that labor costs are much smaller for the transparent fuzes. In addition, the plastic parts are lighter in weight than the fiber fuzes and thus save shipping costs. The fact that the plastic has a very low water absorption as compared to fiber tubing would seem to offer a distinct advantage for this electrical application.

Both sizes of the fuze are molded of cellulose acetobutyrate in an 8-cavity injection mold. The large part which requires 424 grams of the material has a 2-min. cycle while the smaller fuze, using 268 grams of the plastic has a 1-min. cycle. These molding cycles were dictated by the extreme internal pressure which is developed when a fuze blows up and by the fact that no spark or fire from the explosion can be permitted to develop outside the case. These conditions made it necessary to design the transparent cases so that maximum elongation is obtained in the material. Otherwise, under extreme internal pressure, the cases would tend to open up and admit the force of the explosion and fire to the outside atmosphere, a dangerous occurrence in a power plant.

These new, streamlined plastic fuzes would seem to offer many advantages. In addition to being light in weight the parts are self-indicating and eliminate the need for testing equipment to determine a blown fuze. Also because of the plastic case and the absence of metal end caps, the fuze is fully insulated.

Credits—Material: Tenite II. Molded by Reynolds Spring Co. for Virginia Electric Manufacturing Corp. for use by U. S. Navy.

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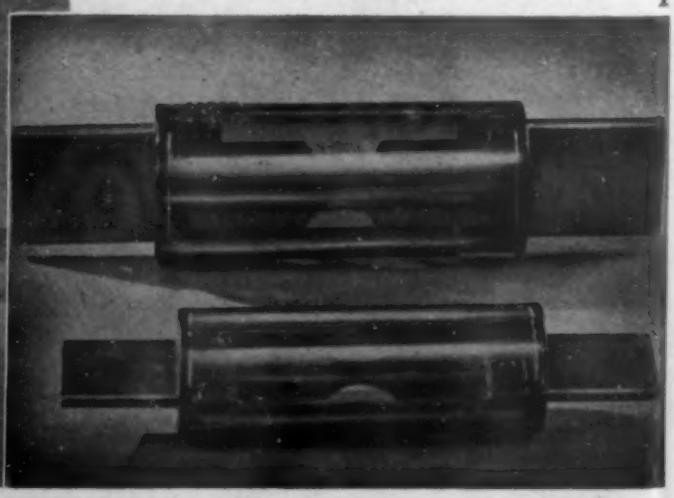


1—The cases for both the large and small knife-blade fuzes are molded in 2 longitudinal halves which are subsequently cemented together. 2—Each of these fuzes consists of 2 copper knife blades, the fuze link and 2 plastic body halves

Electric drill housing

by WILLIAM H. GOTTLIEB

With women and inexperienced workers filling a high percentage of today's production jobs, the light weight and good insulating properties of this hand drill tend to improve drilling efficiency and reduce industrial accidents

PHOTO, COURTESY BLACK & DECKER MFG. CO.

HUGE stamping presses, large turret lathes and swinging overhead cranes are the type of equipment which most people have in mind when they think of the manufacturing plants responsible for our present, all-out war production. But before most of these implements of war can roll off the assembly lines, there are numerous small hand jobs which must be done, and none of these is more important than that of drilling holes for rivets and fixtures. This is particularly true of airplane manufacture where hand drills are used for drilling holes in the skin of metal aircraft at places indicated by master patterns. In many places in the plane's interior where brackets and fixtures are screwed, bolted or riveted in position, these same hand drills are depended upon to make the holes for the attachment of these fixtures.

During the early days of the war this work was accomplished by electric hand drills with aluminum casings. The light weight of this housing material, combined with its good strength and stability characteristics, made it especially suitable for use in industries where women workers were taking the place of their more experienced brothers. While tool conservation is standard practice in all war plants, ordinary hard usage plus some neglect and ignorance ensures that electric hand drills get quite a battering during their serviceable life and must, therefore, be made of durable materials.

When aluminum became scarce, Black & Decker Mfg. Co. selected a high-impact, rag-filled phenolic compound as the best material with which to replace the critical metal in the housings of its electric drills. Preliminary experiments with the new plastic material were carried out on the company's $^1/_4$-in. and $^3/_8$-in. standard drills. Extensive tests have shown that this new line of plastic drills, which now is in full production, has numerous advantages in addition to that of saving nearly 3 lb. of aluminum per tool.

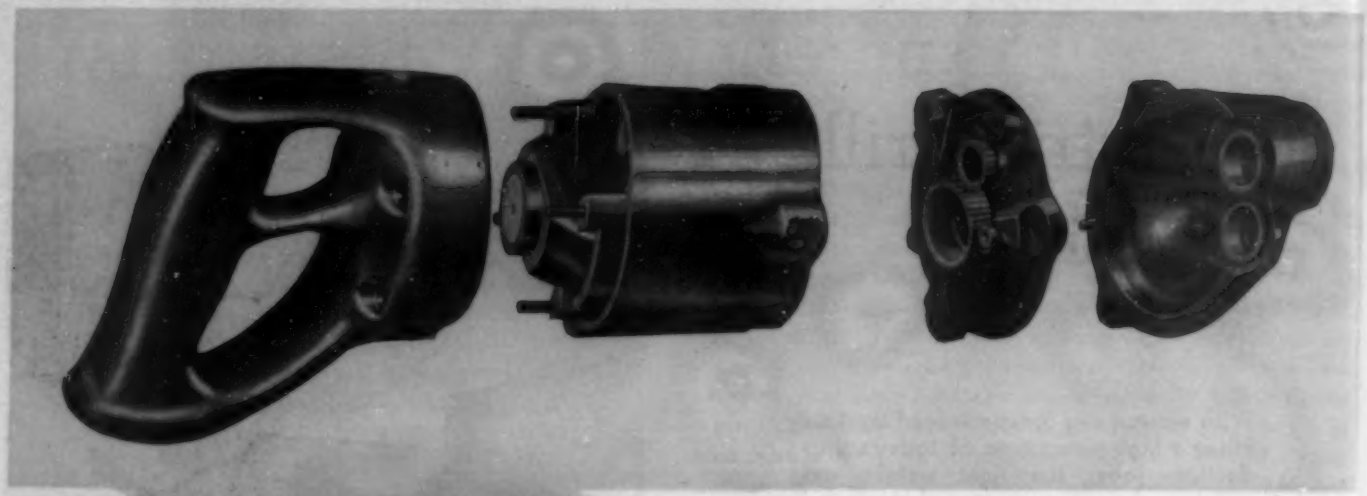
The plastic housing is considerably lighter than the aluminum casing which it replaces. The completely assembled standard end-handle drill, which has a saw-handle grip and is used for heavier drilling, weighs $4^3/_4$ lb. in plastic as compared to $5^1/_2$ lb. in aluminum. This $^3/_4$-lb. saving in weight compares to a $^7/_8$-lb. saving in the side-handled tool. This latter pistol-grip type, which is used for lighter drilling, weighs $4^5/_8$ lb. in plastic and $5^1/_2$ lb. in aluminum.

The modern styling of the phenolic housings of these drills is of great importance in the merchandising of products of this character. Even more important are the dielectric properties of the plastic material which greatly reduce the danger of shock to the operator from an accidental ground in the tool itself. The dielectric strength of the phenolic material is approximately 200–250 v.p.m. at 25° C. Adding to the comfort of the drill operator are the good insulating qualities of the plastic which prevent the housing of the tool becoming uncomfortably hot. Finally, the drill manufacturer found that a number of machining operations were eliminated when plastic housings superseded sand-cast aluminum drill casings.

Each of the two types of drill housings are molded in 5 parts by transfer and compression using pressures varying from 3 to 5 tons per square inch. The saw-handle-grip type drill, which requires the use of two hands for its operation, is made up of a switch handle, a handle cover, a field housing, a gear case cover and a gear case. Seven different kinds of inserts are used in this model—a total of 15 for each drill. The side-handle drill, which can be operated with one hand, consists of the gear case, the gear case cover, the switch handle field case, the handle cover and the bonnet or end piece. A total of 16 inserts are employed in molding this smaller unit.

Little or no difficulty was encountered in working out the mold design of 6 of these 10 parts, which are straight compression-type molds. However, the remaining 4 parts presented some rather difficult molding problems. These pieces were the bonnet and switch handle field case for the side-handle drill, and the field housing and switch handle on the saw-handle-grip type model. (*Please turn to next page*)

PHOTO, COURTESY BLACK & DECKER MFG. CO.



3 On the bonnet or end piece, two holes had to be molded opposite each other and 45° off the vertical center line. This difficulty was solved by designing the mold so the members which mold these holes eject with the part and then are drawn from the part freely and reassembled for the next charge.

The problems presented in the molding of the switch-handle field case were due to the undercuts and depressions inside the housing and on the outside handle section. A further complication was presented by 10 molded-in inserts. Four of these inserts were long, threaded studs which had to be anchored deeply in the material. Transfer molding was finally selected as the best solution to the difficulties. In order to draw the part from the mold, an angle-type or 2-ram press mold was designed which incorporated a loose or movable member to mold each of the inside undercuts. A third loose member was used to mold the end of the part containing
4 the stud inserts. In addition to facilitating loading of the in-

***2**—Explosion view of the saw-handle-grip type drill showing the 4 principal molded phenolic parts. **3**—One of the difficulties encountered in molding the saw handle grip was due to the long, thin wire holes which run at a 45° angle from the base of the part. **4**—Molded-in inserts, and undercuts and depressions presented the most difficult problems in the molding of the field housing on the saw-handle-grip drill. **5**—A transfer-type angle press was used for the molding of the saw-handle grip. **6**—The field housing of the saw-handle-grip type drill is transfer molded in a single-ram instead of a 2-ram press*

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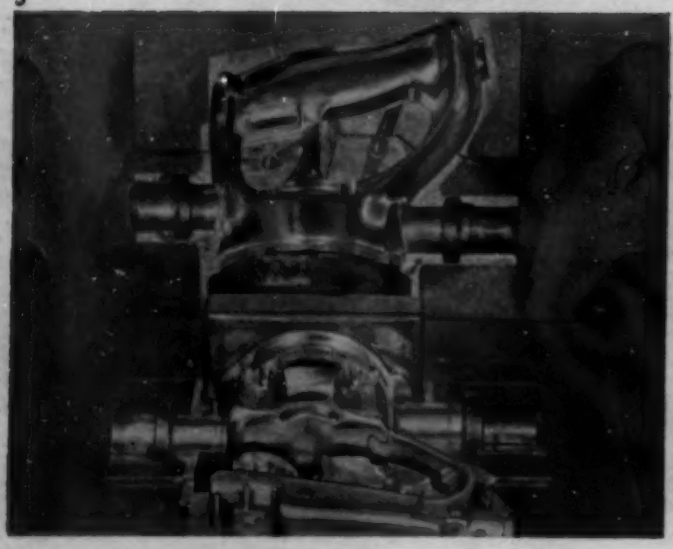
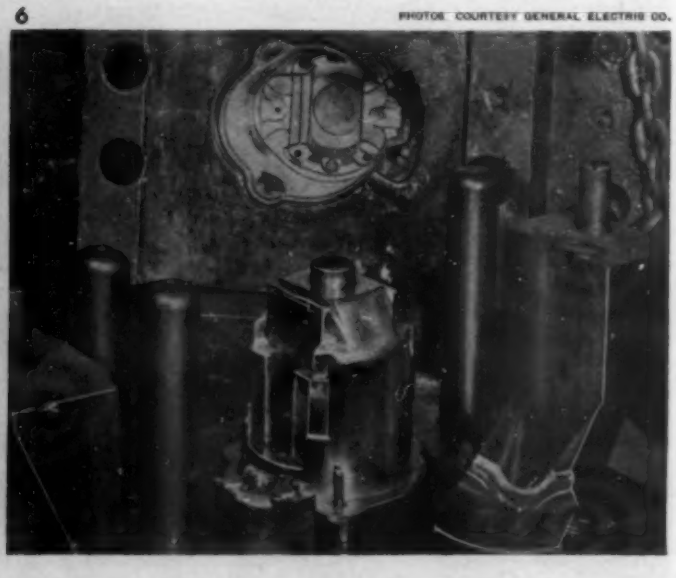


6 PHOTOS COURTESY GENERAL ELECTRIC CO.



serts, this design made it possible to mold the odd-shaped end.

Except for the absence of the long handle, the mold for the field housing on the saw-handle-grip type drill is very similar to that of the switch-handle field case just described. This difference, however, permitted the adoption of a single-ram, transfer-type mold instead of the two-ram press mold.

Although the field case switch handle or saw-handle grip has only 2 molded-in inserts, it presented several molding difficulties. The most troublesome problem was the molding of the long, thin wire hole which runs at a 45° angle from the base of the part. Since a condition of this nature indicates that both ends of the mold member should be supported, it was necessary to design the mold so that support be given to the small end of the member. The large end was dovetailed into the loose member which makes the open end, and the large holes on either side also were molded with loose members. In all this made 4 removable or loose members which are assembled in the lower half of the mold which also molds the cored-out side of the handle. Due to the design, an angle press was necessary. In addition, the design of the mold made it suitable for transfer-type molding which was considered necessary because of the long thin pin. Once suitable fixtures were worked out for the removal of mold members from the ejected parts, the design proved satisfactory.

In the finishing operation on the drill parts, the gates are removed and the pieces are sanded and buffed. Some of the holes are redrilled to greater depth. Following this operation the threads are tapped. Some counterboring of holes is necessary where the direction of draw would not permit molding. According to the tool manufacturer, there has been little or no difficulty in assembling the parts, and tolerances have been held extremely accurately.

Credits—Material: Textolite. Molded by General Electric Co. for Black & Decker Mfg. Co.

PHOTO, COURTESY BLACK & DECKER MFG. CO

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7**—The side-handle drill consists of a gear case, a gear case cover, a switch-handle field case, a handle cover and a bonnet or end piece.* **8—On the bonnet, 2 holes are molded opposite each other and 45° off the vertical center line.* **9***—Undercuts and depressions as well as 10 molded-in inserts complicated the molding of the switch-handle field case.* **10***—To draw the field case from the mold, an angle-type press mold was designed to incorporate a loose member to mold each inside undercut.* **11***—Members which mold the 2 holes on the bonnet, eject with the part and then are drawn freely from the piece*

10 PHOTOS, COURTESY GENERAL ELECTRIC CO.

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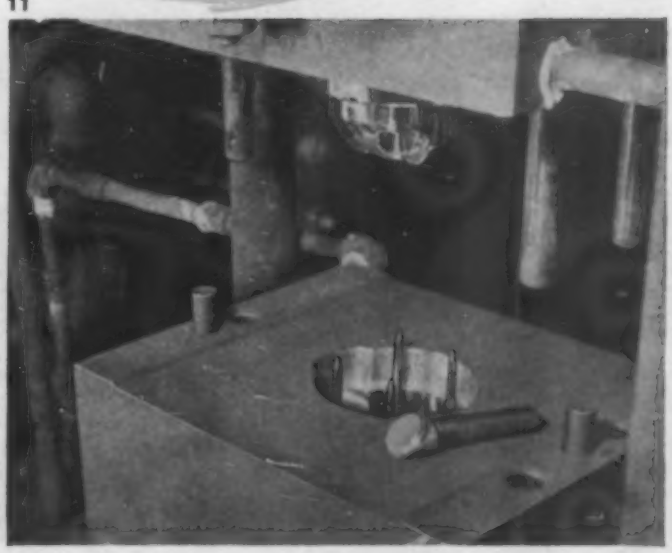

PHOTO, COURTESY METAPLAST CORP.

Army, Navy and Marine Corps have adopted a gold-plated cellulose acetate button as standard insignia for men honorably discharged since the adoption of the Selective Service Act. The accompanying photo shows buttons before and after the gold plating process

The honorable discharge button

by RAYMOND R. DICKEY*

DURING the last war it was a not uncommon experience for returning disabled soldiers who had been mustered out of the service to be handed a "white feather" by overzealous patriots. Already in this war, there have been several reports of similar occurrences. One story, repeated in a popular magazine, tells of a returned hero from Guadalcanal, twice decorated for bravery and discharged because of severe injuries, who replied to the sneering remarks of three "parade ground" soldiers by literally knocking their heads together.

In order to prevent episodes of this nature and give concrete evidence of service in the armed forces, the Army, Navy and Marine Corps have adopted as standard insignia a gold-plated cellulose acetate button for all men who have been honorably dismissed from duty since the adoption of the Selective Service Act. Specifications for the buttons allowed the use of either a one- or two-piece mold. However, most of the buttons which have been supplied to the government were formed in two-piece molds, and the front and back welded together with acetone. Buttons are formed in 24-cavity molds, using the molding cycles generally employed for medium hard acetate.

As called for in the original specifications, the .003-in. silver plating had to be deposited on the buttons in the first instance, followed by a flash plating of gold to the amount of 1.5 grains per dozen buttons. The job was somewhat complicated by the fact that the solution for electroplating the part was silver cyanide, and cyanide (*Please turn to page 170*)

* Manager, Plastics Div., Monroe Auto Equipment Co.

2—*First step in plating these plastic pieces is a treatment given to insure the button's electrical conductivity.*
3—*After gold plating, buttons are lacquered in a centrifugal machine. About 3,000 are lacquered at one spinning*

PHOTOS, COURTESY MONROE AUTO EQUIPMENT CO.

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Paper-base laminates in aircraft*

by CHARLES F. MARSCHNER†

RECOGNIZING the inherent advantages of low-density materials in their application to aircraft structures, the McDonnell Aircraft Corp. initiated a plastics development program in 1939. This program had two main goals: 1) the achievement of substantial increases in the mechanical properties of plastics and 2) a decrease in the molding pressures required in forming these plastics. The program was actively encouraged by the engineering personnel of the Army Air Forces Matériel Center at Wright Field. The Forest Products Laboratory and the Formica Insulation Co. contributed heavily to the fund of technical knowledge required.

Up until about 5 years ago surprisingly little had been done to improve the strength of plastics. Generally, these materials were used because of their inherently good electrical properties. Little attention was given to their mechanical properties which, from a structural engineer's viewpoint, were discouragingly low even when their low density was taken into account. Coupled with the disadvantage of low strength was the requirement that all the laminates which were the most promising from the strength standpoint, had to be molded to shape at very high pressures. These high pressures were obviously a disadvantage when the large areas usually encountered on aircraft parts were considered. Presses of thousands of tons capacity and dies having thousands of square inches of working surface subjected to the high unit pressures, were out of the question because of their high cost and non-availability.

Disregarding momentarily the disadvantages of high molding pressures, a series of mechanical tests were initiated on commercially available paper-base and fabric-base materials employing various types of papers and fabric weaves. In addition, tests were run on experimental materials incorporating fillers such as aligned glass fibers, cotton cords, flax strands, sisal fibers, and the like. The effects of resin content, molding pressure, molding cycle, etc., also were investigated.

Conclusions from experimental tests

From the initial tests, several very important facts soon became evident, and certain theories were confirmed. Some of these are summarized in the following paragraphs.

Relatively little standardization of mechanical test methods for plastics existed. This condition has since been rectified through the joint efforts of the Army, Navy, National Bureau of Standards and the plastics industry.

Phenolic resins seem to provide the best inter-fiber bonds. Other resins are now being developed which will be as satisfactory as phenolics in this respect.

The lateral displacement of fibers caused by weaving, by twisting the strands or by a combination of these two factors, makes it impossible to develop the full strength and modulus of the fibers.

Reductions in resin content to a practical minimum provide better mechanical properties by permitting an increase in the number of strength-giving fibers for a given quantity or weight of finished laminate.

High strength can be achieved only by using a filler material of a fibrous nature. Furthermore, the fibers themselves must have a strength-weight ratio substantially greater than that of the best metal alloys. This is essential in order to make up for the low tensile strength of the resins and to provide high strength even when the laminae are crossed and only half the fibers may be "working." It is useless to employ metal mesh or wires in the laminate in order to provide strength since the strength-weight ratio will always be less than that of the metal alone.

Glass laminates are inherently denser than laminates incorporating natural fibers because the glass itself has a specific gravity of about 2.5 as compared to about 1.4 to 1.5 for natural fibers. The higher density of glass laminates renders them less desirable as an isotropic material where buckling stability is desired.

The compressive strength of laminates in a direction parallel to the laminae depends largely upon the effectiveness of the resin as a bonding agent. Too great a decrease in resin content cannot be tolerated if good edgewise compressive strength is desired. A 35 percent resin content appears to be about the practical minimum for paper-base laminates.

For each molding pressure there appears to be an optimum resin content to provide optimum tensile strength for a given type resin and filler material.

Due to the anistropy possible with papers and also perhaps to the natural-fiber bond produced in paper manufacture, paper-base laminates will give at least as high strength- and moduli-values for their weight as any type of filled plastics thus far developed.

From the cost standpoint, paper seems to provide the lowest cost filler which will provide the desired strength properties. Recent developments in the production of very highly anistropic mats made up from very long natural fibers, promise to result in exceptional strength at costs somewhat higher than paper but still substantially lower than cloth.

For many applications, specific gravities lower than the usual 1.3 to 1.4 of laminates are desirable in a structural material. The increased use of sandwich-type construction to achieve 0.25 to 0.35 over-all specific gravities is to be expected.

Conclusions from low-pressure molding tests

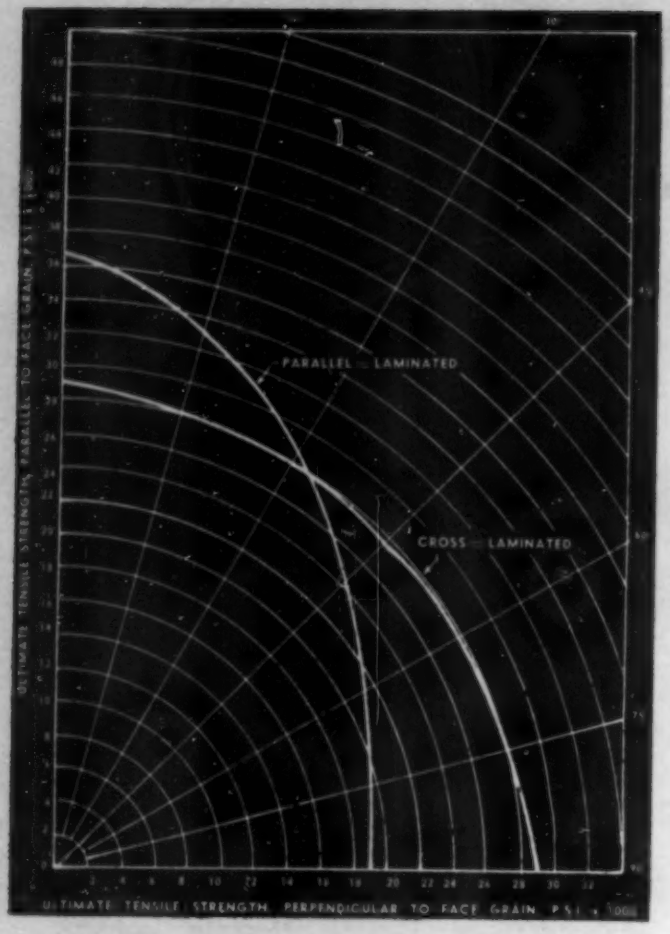
Paralleling the mechanical tests, a series of low-pressure molding tests were conducted to determine uses and possibilities of various methods and types of dies. These tests included the use of rubber bags, rubber die punches, plastic die punches, sprayed metal dies and plated metal dies as well as cast and machined dies. The following conclusions were drawn from the results of these molding tests.

Low molding pressures of 250 p.s.i., or less, permit the use of "soft" metal dies which are cheap to cast and finish and which may be put into use in a relatively short time.

Low molding pressures reduce or eliminate the need for

* Presented before a joint meeting of the Rubber and Plastics Group and Aviation Division of American Society of Mechanical Engineers, New York, on Dec. 1, 1943.

† McDonnell Aircraft Corp.



1—Graph showing ultimate tensile properties through complete range of angles to face grain of both parallel- and cross-laminated high-strength paper-base plastics

large, heavy-duty press equipment. Hence the capital investment ordinarily put into such equipment may be saved or utilized for rounding out the range of plastics manufacturing facilities which is required.

Cast Kirksite dies are satisfactory and relatively inexpensive for limited production runs. They should be plated if more than 300 to 400 parts are to be produced.

As would be expected, plated cast-steel dies are justified if production exceeds 2500 to 3000 parts.

Sprayed metal and plated dies can be used with limitations which are primarily imposed by the shape of the part and the details of die construction inherent with the shape. This type of die should not be used at pressures exceeding 200 p.s.i. unless the parts being molded are relatively "flat."

Any normal die-set utilizing a rubber membrane (as in bag molding) or a rubber pad, is likely to be unsatisfactory because of the "roughness" of the molding on the side of the rubber. This roughness somewhat reduces the strength of the part and, of course, is definitely detrimental when aerodynamic contours are to be maintained. This does not apply to resin-bonded molded plywood.

Because of the lack of "stretch" in the dense, impregnated high-strength papers, it is necessary to "tailor" the build-ups carefully to insure good moldings. While tailoring is usually a hit-or-miss proposition, practically all build-ups can and should be developed on the drafting board. This saves much time in the shop.

The increased application of "contact-pressure" resins coupled with decreased curing cycles and the further development and availability of high-frequency heating, will undoubtedly result in the use of plaster and plastic dies for certain types of jobs.

Developments in low-cost molding methods must be continued, and it may be expected that, for comparable items in metal and plastic, the tooling for plastics will ultimately be as cheap or cheaper than the tooling for metal. Much depends upon the development of plastic materials.

In considering the design of a plastic unit, the temptation to try to mold it in a single piece must often be resisted. Frequently, it is less expensive to make several separate moldings and then to assemble them by bonding or by mechanical fasteners. Initial production deliveries can often be expedited by the assembly method of fabrication because molding problems are simplified and dies more quickly produced.

Properties of paper-base plastics

The mechanical characteristics and advantages of certain plastic materials for aircraft use in general, have been adequately discussed previously (see references 1 through 12 at

TABLE I.—MECHANICAL CHARACTERISTICS OF HIGH-STRENGTH-PAPER PHENOLIC LAMINATES

Property	*Paper-base plastic*	
	Parallel-laminated	*Cross-laminated*
Specific gravity	1.35–1.40	1.35–1.40
Tension		
Ultimate, with grain, p.s.i.	35,000	25,000
Ultimate, across grain, p.s.i.	18,000	25,000
Modulus of elasticity, with grain, p.s.i.	3,000,000	2,300,000
Modulus of elasticity, across grain, p.s.i.	1,500,000	2,300,000
Compression		
Ultimate, edgewise with grain, p.s.i.	19,000	18,000
Ultimate, edgewise across grain, p.s.i.	17,000	18,000
Ultimate, flatwise, p.s.i.	40,000	40,000
Flexure		
Modulus of rupture, with grain, p.s.i.	32,000	26,000
Modulus of rupture, across grain, p.s.i.	20,000	26,000
Modulus of elasticity, with grain, p.s.i.	3,000,000	2,000,000
Modulus of elasticity, across grain, p.s.i.	1,500,000	2,000,000
Shear		
Edgewise, across grain, p.s.i.	13,500	13,000
Edgewise, with grain, p.s.i.	13,000	13,000
Flatwise, across grain, p.s.i.	12,500	11,500
Flatwise, with grain, p.s.i.	11,000	11,500
Bearing—mean values		
With grain, p.s.i.	30,000	30,000
Across grain, p.s.i.	30,000	30,000
(See pin diameter vs. material thickness curves for specific design data)		
Hardness, Rockwell	M100	M100
Water absorption (24 hr. total immersion)		
1/8 × 1 × 3 in. specimen (unsealed edges), percent	3–4	3–4
1/8 × 1 × 3 in. specimen (sealed edges), percent	1–2	1–2

Remarks: (1.) Material is not affected by oil or high octane gasoline.
(2.) The above values may be used for design.

the end of this paper). Table I is presented to show typical values for currently available high-strength paper-base plastics. It is interesting to compare these strength values with those published for the commercial paper-base plastics of 3 or 4 yr. ago. In most instances ultimate strength and elastic modulus values have been increased by over 100 percent.

While it is usually hazardous to predict material developments and advances, there is good reason to believe that improvements in laminates during the next 5 yr. will result in ultimate tensile values of 40,000 p.s.i. in cross-laminated materials and 60,000 p.s.i. in parallel-laminated materials with elastic moduli of 4×10^6 and 6×10^6 p.s.i., respectively. Values for shear, bearing, compression, flexure and related properties may be expected to show proportional increases.

The strength properties of parallel- and cross-laminated paper-base materials at various angles to the grain of the face sheet are often desired. A complete exploration of all properties at various representative angles has not yet been completed, but Figs. 1 and 2 are presented to show the ultimate tensile strength and tension modulus, respectively, throughout a complete range of angles. They indicate, when compared and coordinated with the data presented in Table I, the variations which might be expected in other mechanical properties at various angles to the face grain. It is interesting to note that a very nearly uniform material results from cross-laminating "grained" sheets. Due to the relative thinness of the high-strength paper and the multiplicity of laminae per sheet of finished crossed laminate, the grain direction of the face sheets has little or no significance except to define a grain direction to which principal loads or other portions of the structure may be referenced.

By comparing the ultimate tensile strength and elastic modulus in the parallel- and cross-grained direction on parallel-laminated material, a very good indication of the degree of anisotropy of the paper itself is obtained. It should be noted from Figs. 1 and 2 that the degree of anisotropy of materials currently being used is approximately 2 to 1. It is also interesting to note that the elastic modulus usually is roughly 100 times the ultimate tensile strength whether the material be parallel- or cross-laminated.

The sheet stock from which these test data were obtained was molded from impregnated stock obtained from Consolidated Water Power and Paper Company. Parts shown in the illustrations in this paper also were molded from the same material. Proper orientation of the grain in the individual laminae will provide any mechanical characteristics between the ranges shown by the curves in Figs. 1 and 2.

Thickness of plastics in aircraft parts

When the production of plastic aircraft parts was initiated, it became obvious that certain standard gages would have to be adopted in order to simplify design, production and the control of raw materials. Inasmuch as most of the aircraft industry is now employing the decimal system of dimensions for fabricated as well as for machined parts, it was felt that uniform gage increments should be adopted on a decimal system. These gages were chosen, as shown in Table II, so that the resulting standard sheet stock would be comparable in weight per unit of area to standard aluminum-alloy gages. In actual practice these gages have been found to work quite satisfactorily.

Raw stock, in the form of impregnated high-strength paper, may now be purchased in mat form. The mats are separated by slip sheets, and each contains the proper number of laminae to make a finished molding 0.040, 0.050 or 0.060 in. thick when molded at about 250 p.s.i. and 300° F. With these three basic mat thicknesses, any of the gages indicated in Table II may be obtained, as well as intermediate non-standard gages in increments of 0.010, starting at 0.090 inch. It is not considered necessary or desirable to employ finer gage increments or gages in fractions of an inch.

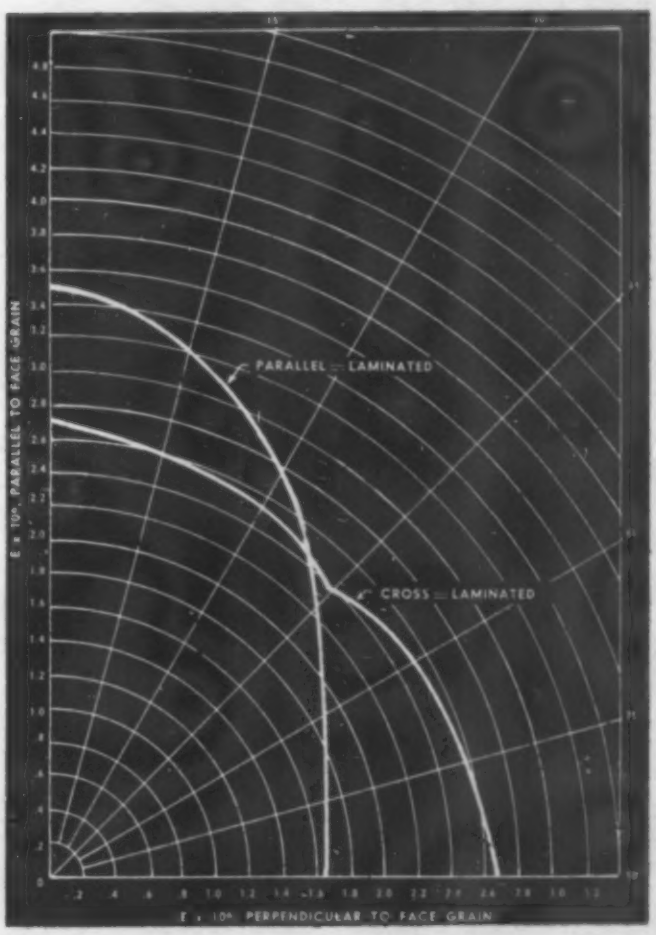
Aircraft parts made of paper-base plastics

Standard gages have been used throughout in fabricating the assemblies and the parts shown in Figs. 3 through 10. These parts are representative of the type now being pro-

TABLE II.—FINISHED THICKNESSES USED IN PLASTICS PARTS FOR AIRCRAFT

Plastic gage in.	*Weight of plastic lb./sq. ft.*	*Comparable aluminum gage (approx.), in.*
.040	.28	.020
.050	.35	.025
.060	.42	.032
.080	.56	.040
.100	.70	.051
.120	.84	.064

Remarks: (1) Gages .040 and .050 in. are only used for special applications where weight is very critical.
(2) Gage increments of .020 up to .240 in. and .060 from .240 in. up.



2—*Chart of elastic modulus properties through complete range of angles to face grain of both the parallel- and cross-laminated high-strength paper-base plastics*

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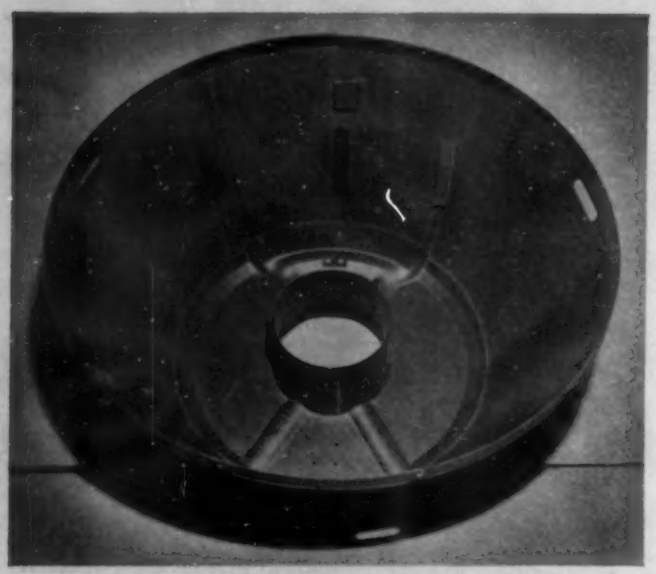

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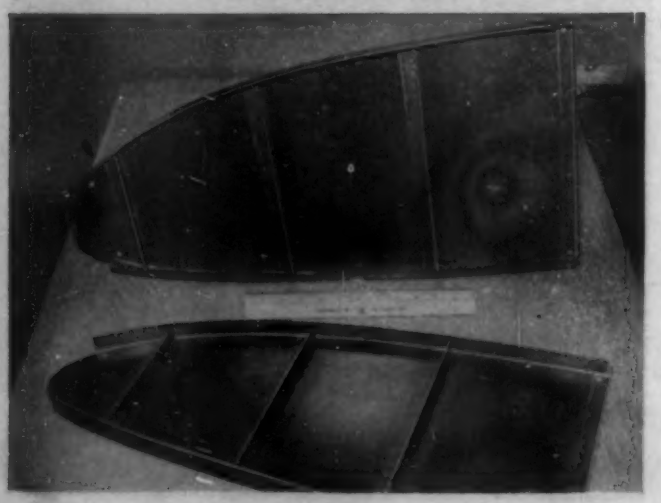

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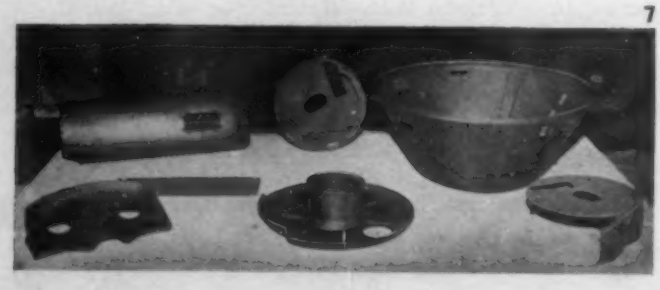
duced from high-strength-paper plastics. Figure 3 shows a plastic gunner's seat which is built up from five separate moldings. Together, these parts represent about every type of molding problem encountered to date. The top of the seat and the stiffening element on the bottom, which cannot be seen in the photograph, are compound curvatures which require the use of tailored blanks. The top is 0.120 in. thick throughout while the stiffener is 0.100 in. thick except for a small portion which is locally reinforced to a total thickness of 0.200 inch. The reinforcement which is molded simultaneously with the rest of the stiffener, is so designed as to produce a taper in thickness from 0.200 to 0.100 inch. The base of the seat is made in three sections for ease of molding—each section being a channel with a curved web. The lower flange is 90° to the web of the channel and contains several joggles. The upper flange is a varying angle to match the contour of the top. Assembly of the seat is accomplished by riveting rather than bonding. The two splices which connect the three parts which form the base of the seat, provide a stiffening element. A weight saving of approximately 43 percent was achieved over the original metal seat design.

Figure 4 shows an assembly of a turret part which consists of six separate moldings. The rim at the top and the hat section fittings are made from aluminum. Assembly of the plastic and metal parts is accomplished by means of rivets and screws which facilitate repair and replacement on combat-damaged parts. The bottom or base molding is 0.180 in. thick and is about 48 percent lighter than the original metal design. It is beaded to increase rigidity, and the opening in the center is flanged to receive the cylindrical sub-assembly which is made up from two 180° × 0.060 in. thick moldings as shown. The three side panels are molded in the flat and post-formed to produce the desired conical shape.

Figure 5 shows a gun cover assembly on which a relatively large number of metal fittings are used. The side panel is a relatively simple shape, but the curved channel sections around the periphery have 90° flanges. The finished moldings are jig drilled for critical locating points, and the cutouts are made on a router. Figure 7 shows other views of the seat, turret and gun cover assemblies as well as a door assembly and fairing assembly in the left background.

Figure 8 shows several standard structural sections which have been used for experimental and production assemblies. Other types of structural shapes, such as H's, I's and Z's, may be made easily. Standardization of certain types of plastic

3—Plastic gunner's seat built-up from 5 separate moldings. 4—Assembly of a turret part which consists of 6 separate moldings. 5—Gun cover assembly on which a relatively large number of metal fittings are used. 6—Two test ribs constructed from molded angles and flat stock. 7—Views of the seat, turret and gun cover assemblies, with door and fairing assemblies in the background



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shapes should be initiated, and the shapes should be developed from fundamental test data which have been and are being developed by the National Advisory Committee for Aeronautics. These data indicate what proportions should be used for all types of structural shapes regardless of the type of material from which the shapes are made. In the past the development of structural shapes has been little more than the outgrowth of custom moldings produced to meet specialized requirements. The availability of a wide range of standard shapes such as are available in steel and aluminum, should ultimately result in substantial savings in design time, delivery of parts and production costs.

Figure 6 shows two test ribs constructed from molded angles and flat stock. Due to the relatively low density and good mechanical characteristics of the material, ribs of this type can be built on a weight parity with metal ribs. Except for a few "tack" rivets at the ends of the stiffening elements, assembly is accomplished by bonding. Fabricated assemblies of this type virtually eliminate the need for highly specialized molding dies and point the way toward the economical construction of very large plastic assemblies even on an experimental basis.

Figure 9 shows interchangeable steel and plastic ammunition boxes. Because of the strength and rigidity of the plastic boxes, very substantial weight savings have been achieved on every redesign for plastics undertaken to date. The boxes are resin-bonded throughout except for the assembly rivets and attachment of the metal piano hinges. Consideration is being given to the use of extruded or molded plastic hinges. Bonding is accomplished on the bonding presses shown in Fig. 10. These specially built presses heat the boxes uniformly and apply the necessary pressure from all sides simultaneously. Stacks of bonded and unbonded boxes are shown in the background. The rivets at the ends of the angles hold the boxes together before the bonding operation. The gage of the material in the particular plastic box shown is 0.060 in., and it may be noted that a weight saving of approximately 40 percent is achieved over the original metal box.

Thus far the gages of the paper-base plastic parts placed in production have not exceeded 0.200 inch. None of the present production parts can be classed as primary structural items. Developmental work on primary structural components has disclosed requirements for plate stock over 0.300 in. thick and having areas exceeding 300 square feet. It has also been indicated that there is a need for "bar" stock in lengths of 10 ft. or greater and in thicknesses exceeding 1 inch. However, it is likely that over 80 percent of the total weight of laminated plastic aircraft parts will be in gages of 0.120 in or less.

8—Several standard structural sections which have been used both for experimental and production assemblies. 9—Two ammunition boxes, one of resin-bonded plastic and one of stainless steel, which can be used interchangeably. 10—Specially built bonding presses for ammunition boxes which heat the boxes uniformly and apply the necessary pressure from all sides simultaneously

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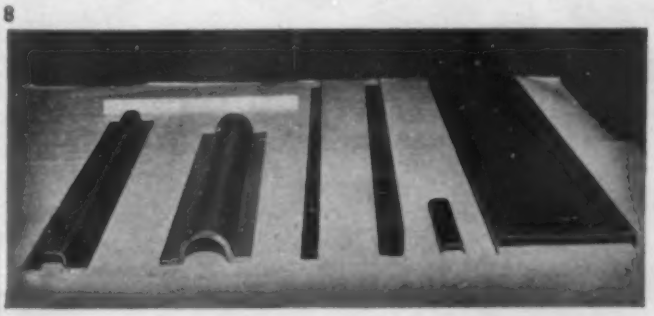

Future developments in paper-base plastics

There are a number of important problems in connection with aligned fiber laminates which require further study and investigation before the full advantages of this type of material can be completely realized. Studies of the relationship between fiber length, fiber strength, fiber alignment and the effectiveness of various types of resins as bonding agents, must be extended to include a wider range of fibrous materials and resins. Work with lignin-enriched resins should be expanded with a view to decreasing resin costs which now represent by far the largest percentage of the material cost in paper-base plastics. The total cost of the raw materials must be reduced to 15 cents per lb. or less if plastic materials are to compete with metals on a really large scale in the post-war period.

Further improved bonding and impregnating characteristics are desirable in order to provide better edgewise compression strength and to enable the full strength of the fibers to be developed in tension. Alternatively to improving the bonding strength of the resins, longer fibers must be used to reduce the unit shear stress on the bond between two joined fibers. When longer fibers are *(Please turn to page 168)*

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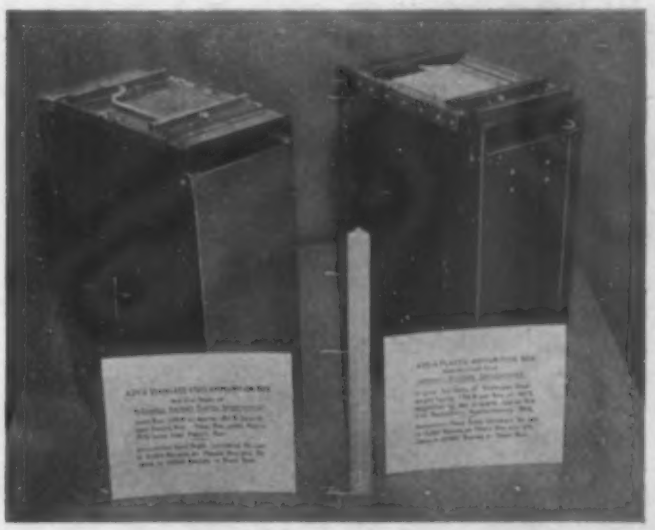

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Wearing the latest model of this all-plastic goggle, a worker is comfortable and safe from eye injury. The goggles come with large or small nosepiece, rolled edges, ventilators and frosted or clear shields of red, green or white

One ounce of precaution

MACHINISTS, welders, smelters and foundrymen all know how easy it is for a fragment of flying metal to strike a man's eye and leave him blind. Yet today a great army of unskilled workers has poured into occupations characterized by a high rate of visual hazard. Some of these people never saw a spot welder, a chipper or an abrasive wheel before they started on their new jobs. Often it is only from bitter experience that they learn the potential dangers that lie behind the spinning wheels of high-geared machines.

To guard against such accidents and the resultant production tie-ups, wartime management has trained its supervisors in safety measures and provided employees with protective equipment. Workers frequently rebelled against these devices, complaining that they were uncomfortable.

About 6 months ago a crystal-clear plastic goggle was produced, weighing only $1^3/_4$ ounces. It is non-shattering, nonfogging, adjustable and equipped with replaceable lenses. Developed as the result of first-hand experience with the old type of safety device, the original models were shaped from scraps of cellulose acetate over a kitchen stove. Since the war had transformed cellulose acetate into an extremely critical material, it was only by dint of obtaining scrap from aircraft plants that enough plastic was secured for the first few hundred goggles. Safety engineers tested these early production models, and the device was finally improved to meet all their specifications. Convinced by these endorsements, the WPB at last allocated the necessary plastic materials and extended an AA-1 priority rating for tools and dies.

The new goggle, consisting of a lens member and a rim member, is fabricated from .050-in. thick cellulose acetate sheet stock. After the material has been cut into $3^1/_2 \times 20$ in. strips, it is heated in an electric oven to a temperature of approximately 112° F., and the lens and rim members blanked out in punch presses. The rim member is passed through much the same process except that the edges are turned to a 90° angle at those points where contact is made with the face.

When the rough edges left by the steel die have been smoothed in a burring machine, the rim and lens members are ready for assembly. This operation consists merely in wrapping the rim member around the lens and locking it. The headband is then laced through the die cut openings.

The units come in two sizes: standard and large. Two models—one with a large nose piece, the other with a small one—are supplied for each size. The integral nose piece serves the double purpose of keeping an old danger spot covered and making it impossible to scratch the lens by laying it flat on the bench surface. In addition to increasing the wearer's comfort, the rolled edges of the rims prevent perspiration from being trapped by sharp corners. Ventilated models provide a further guard against fogging. Adjustability is secured by built-in plastic buckles attached to a headband which contains an elastic insert. The size range of the goggles makes it possible to fit them over ordinary glasses.

Light absorption and distortion tests show that the visual efficiency of the plastic lenses fully equals that of the glass safety goggle. On the other hand, the impact resistance of the cellulose acetate unit is considerably higher than that of the older device. This is evident from the fact that the minimum velocity required for a B.B. shot weighing .490 gram to penetrate the plastic is 350 ft. per sec. as compared with a velocity of 200 ft. per sec. for the standard glass lens.

Credits—Material: Lumarith, Plasticele, Nixonite. Fabricated by Du Bois Plastic Products, Inc.

A self-contained compass

by CHARLES LICHTENBERG*

MECHANIZED armies often travel and fight in unfamiliar regions where signposts are destroyed and road networks unusable, where the route forward is an endless expanse of shifting sand. Yet the outcome of most military engagements depends upon the precision movement of combat vehicles and their supply trucks. Plans for attack permit of no delays because of faulty or inaccurate calculations as to direction. A like situation exists in regard to the movement of landing craft and similar Naval vessels. All these conditions created the need for simple, compact and reliable compasses for installation on tanks, tank destroyers, mobile artillery and other combat vehicles as well as on various small Navy ships.

The solution to this difficulty is a compass developed by Sherrill Research Corp. for the Army Ordnance Department, which has become standard equipment for the Army's mobile units and also is used by the Navy. The design of this compass is an achievement in the application of plastics to a precision product. Virtually all the working parts with the exception of the magnet are molded of one of four different types of plastics—phenol formaldehyde, methyl methacrylate, cellulose acetate and cellulose nitrate.

Striking economy in cost and in weight has been achieved by the use of plastics in this ordnance piece. A saving of 7 to 8 lb. per unit has been obtained by the replacement of such critical metals as bronze, brass and aluminum. In addition, the plastic compass is produced and sold to the Government at a price markedly lower than competitive products.

* Sales manager, Molding Materials Dept., Plastics Div., Monsanto Chemical Co.

Like all instruments of this type, the heart of the Sherrill compass is a cellulose acetate card carrying a magnetic element which floats free in a transparent methyl methacrylate bowl containing non-freezing liquid. Two small highly magnetized bars fixed to the card replace the magnetic needle so that regardless of the position of the bowl the card maintains a constant relationship to magnetic North. However, if this were all that was required to provide accurate reading, the development and production of the compass would have been a simple matter.

But other important considerations come into play. A magnetic compass is subject to several different types of error. Large masses of metal near the instrument are one important source. When a compass is installed, the metal of armor, guns and engine influence the card and throw it off completely. To compensate for this source of error, the plastic compass is provided with a so-called quadrantal compensator which is mounted below the bowl as shown in Fig. 4 and consists of a brass rod to which spokes are attached. Collars of magnetic metal are added to these spokes in such fashion as to set up a force compensating the influence of the disturbing masses of metal. The spokes to which the collars should be attached are determined by heading the vehicle to 45, 225, 135 and 315°, recording the readings and errors, and calculating average errors. These magnetic collars are set in place when the compass is installed, and they need not be touched so long as the instrument remains in the same vehicle and in the same position.

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OFFICIAL PHOTO, U. S. SIGNAL CORPS

PHOTOS, COURTESY SHERRILL RESEARCH CORP.

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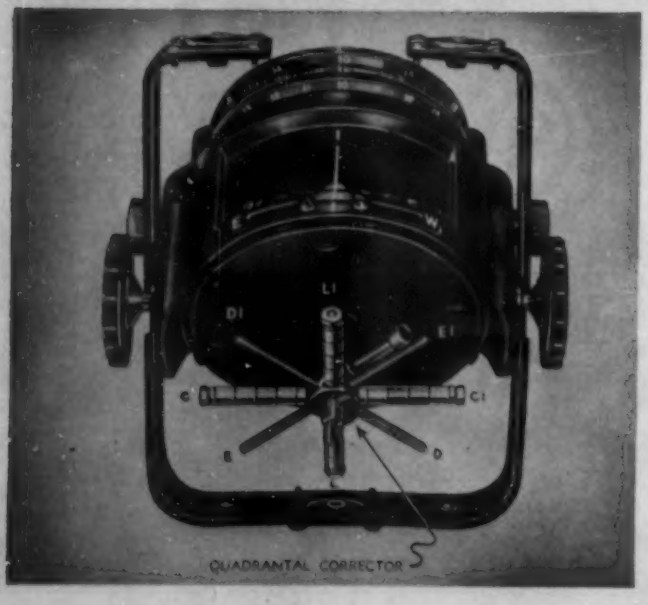

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Another condition affecting the accuracy of the compass develops when the vehicle in which it is installed is tipped from one side to another. During such movements the card carrying the magnetic element tends to float out of correct reading. This tendency is overcome in this compass by the so-called heeling corrector which is located at the top of the instrument (Fig. 3). This part, which is molded of cellulose acetate, is provided with a series of longitudinal holes into which are dropped small lengths of metal rod. In order to determine where the rods should be inserted, the vehicle is headed true North and a reading taken. Then the carrier is tipped on one side to an angle of approximately 10°. Again the compass reading is recorded. The difference between these two readings is the amount of heeling error. Magnets then are inserted in a symmetrical pattern in the vertical holes until the reading returns as close as possible to that which was recorded when the instrument was heading true North and the tank was on the level. Like the quadrantal correction, this adjustment is made in the vehicle after compass is installed.

Further correction of the reading is obtained by resetting of semi-circular correctors (Fig. 3) which are molded of phenolic material. Both fine and rough adjustments are obtained by these alterations. Access to the correctors and to the four different phenolic knurled knobs which motivate them, is secured by loosening the threaded phenolic outer knob located at the top of the instrument (Fig. 2). Four separate banks are provided in this intricate mechanism. Each small adjusting knob actuates an intricate designed gear train which produces a movement of two geared phenolic wheels located in the center of the plate. On these geared wheels are mounted very small magnets which influence the magnetic card floating free in its liquid. To determine exactly how much each of these small knobs must be moved in order to achieve exact compass readings, the vehicle must be turned in various directions, readings taken and the amount of error noted for each position. Various calculations based on these recordings indicate adjustments necessary for that particular vehicle.

The successful operation of the compass centers in the transparent methyl methacrylate bowl and cellulose acetate compass card and cap. Cellulose acetate has been found to provide the proper combination of dimensional stability and buoyancy needed for the compass card assembly. The cap on this unit is cemented into position after a predetermined amount of air is trapped—permitting the card to float in the liquid. The other two plastic parts of the bowl assembly consist of a small methyl methacrylate plug and a diminutive vertical guide of cellulose acetate which acts as a bearing for the card. This entire assembly is vacuum tested at 9 in. of mercury for 2 hr. and exposed to temperatures between +160 and −60° F. for a like period.

2—Except for the magnet, virtually all working parts of this compass which is used in tanks, combat vehicles, landing barges and similar craft, are molded of one of 4 types of plastics. 3—To insure compass accuracy even when a vehicle is tipped from side to side, this plastic-type model is equipped with a heeling corrector which can be regulated to compensate for irregular movement. The semi-circular correctors permit further correction of the reading. 4—Since masses of metal near the instrument also affect the accuracy of its reading, this compass incorporates a quadrantal compensator which is mounted below the bowl and consists of a brass rod with spokes attached, to which metal collars can be added

PHOTO, COURTESY E. I. DU PONT DE NEMOURS AND CO., INC.

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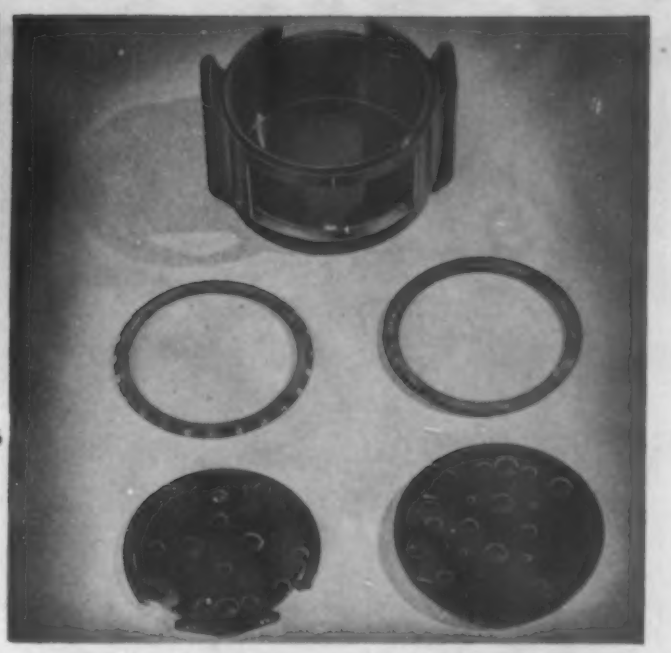

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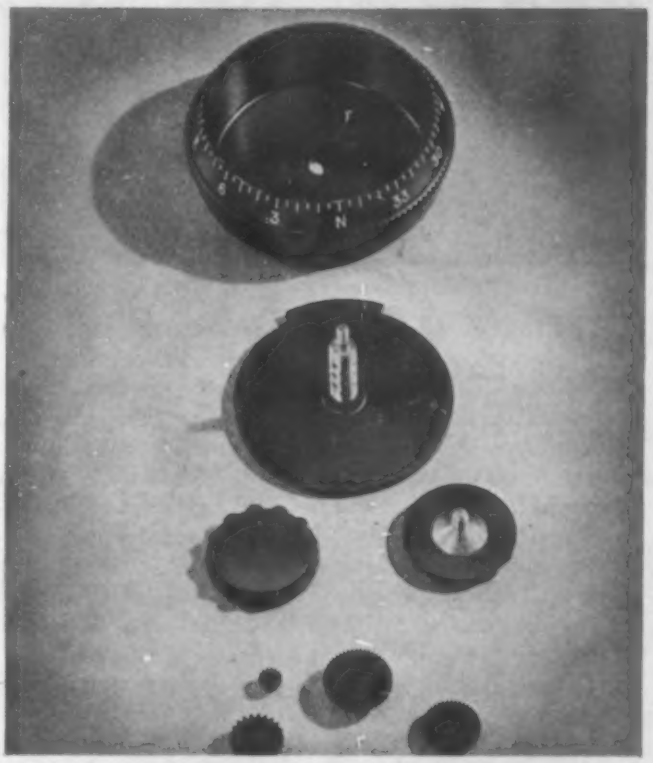

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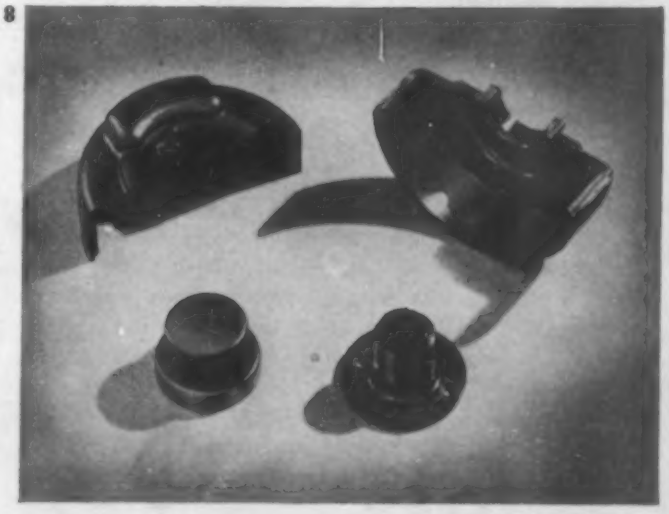

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A methyl methacrylate baffle plate is cemented into the recessed rim of the bowl. This baffle is provided with holes to permit the flow of liquid from the bowl to the upper chamber as required by the expansion and contraction of the liquid at various temperatures. After all air has been expelled from the compass fluid, a flexible diaphragm of cellulose nitrate is cemented over the transparent plate. This sealing disc forms a narrow chamber connected to the main part of the bowl through the holes in the baffle plate. Cellulose nitrate is specified for this part because its natural resiliency allows contraction and expansion of the compass liquid.

Except for the heeling corrector and movable index (Fig. 5) which are molded of cellulose acetate, all other parts in the Sherrill compass are of general-purpose phenolic which was specified because of its rigidity, strength, dimensional stability and ability to withstand the jolts and rough treatment of combat conditions. These parts include the bowl receptacle which holds the transparent liquid container, outer gears and indicators, and gear train plates which can be seen in Fig. 6. Other phenolic compass pieces (Fig. 7) are the lower cover and course indicator, base and rod of quadrantal compensator, mounting knobs and gears. The top cover which is molded in two sections and the cap knob are of this same material. These parts are shown together with the cellulose acetate heeling corrector in Fig. 8.

Nine injection molds and 20 compression molds costing in excess of $100,000 and containing 226 cavities are employed for the molding of the 29 different plastic parts which comprise this compass. With this equipment, 750 complete compasses or 44,250 separate parts are turned out each day. All of the compression molds are automatic steam molds, designed for operation in presses ranging from 150 to 450 tons. The molds which produce the main housings are highly developed and a train of gears, mechanically operated, is used to pull the window plugs away (*Please turn to page 170*)

***5**—Reading from left to right in this illustration are the methyl methacrylate baffle plate and bowl, and the cellulose acetate vertical guide, compass card and cap, heeling corrector and movable index.* **6**—*Among the parts which are molded of phenolic material are the bowl receptacle (top) which holds the transparent liquid container, 2 outer gears and indicators (center) and 2 gear train plates.* **7**—*Other phenolic compass parts are the lower cover (top), base and rod of the quadrantal compensator (center), and various knobs and gears.* **8**—*The top cover is molded in 2 sections of a phenolic material. The cap knob (left) also is of phenolic whereas the heeling corrector (right) is molded of cellulose acetate.*

Army mess tray

by LEE T. BORDNER*

A test-proven mess tray of melamine-formaldehyde designed to meet the highly specialized requirements of Army hospitals

WHILE the use of plastics in the fabrication of parts for the various branches of the Armed Services has expanded tremendously during the past years, the employment of these materials in the Medical Corps has been somewhat limited. Although this division has used synthetics in the making of stethoscope bells, instrument handles, blood pressure instruments, etc., it was not until a melamine-formaldehyde mess tray for invalid soldiers was approved, that plastics were used by this Corps in any appreciable volume. A similar mess tray is already in use in the Navy, but there were certain requirements set up by the Quartermaster Corps, acting as the procuring agency for the Medical Corps, which had to be met before the tray could be accepted by the Army Service Forces. These conditions were necessarily rigid because the tray was to be used to serve meals to boys recuperating in hospitals and institutions. It had to be non-toxic, of exceptional impact resistance, able to take the daily abuse of a dish-washing machine and capable of retaining its polished surface after continued daily usage.

The accepted tray (Fig. 2) has 6 compartments of various sizes, and is so designed that the sections can be adapted to the type of meal being served. A $\frac{1}{8}$-in. R bead molded around the under side of the rim allows the tray to fit snugly into the rack of a serving truck. The minimum thickness of the tray is 0.125 in., its average weight is about $1\frac{1}{2}$ lb. and its surface is capable of retaining a high permanent luster. One advantage of plastics for this application which was not anticipated, lies in the natural insulating properties of the material.

Material

After considering and testing various plastic materials the Quartermaster Corps specified a melamine-formaldehyde for these mess trays—a material which was found to possess all of the required physical and chemical properties. Trays molded from melamine were light in weight, had good impact resistance and flexural strength, possessed a hard surface, were odorless, would not stain, did not warp, could be cleaned in a dish-washing machine and neatly stacked.

In order to assure quality production the Quartermaster Corps established certain specifications covering materials, molding, finishing and tests. The molding material was specified as "a first-grade melamine-formaldehyde resin modified with not more than 18 percent phenol." The designated filler was chopped or macerated cotton since tests have shown that such melamine compounds possess the properties required for this application. The color specification was natural tan "with slight variations permissible due to the texture of the fiber."

The material specifications required an Izod impact strength of not less than 1.2 ft./lb. per in. of notch, and a flexural strength of not less than 12,000 p.s.i., with a deflection of not less than 56 mils. The manufacturer was required to furnish reports on impact, flexural and deflection tests made on each batch of processed material. He also was obliged to produce evidence from the Office of the Surgeon General, attesting to the lack of toxicity of the formulation. In reporting on the tests made by the Surgeon General it was stated that complete polymerization of the plastic would eliminate any toxic hazard and that if a phenolic or other odor could be detected, it would indicate that complete polymerization had not been accomplished and that such trays might therefore be potentially toxic. Tests have shown that a 5 to 6-min. molding cycle completely eliminates toxicity of the formulation.

Molds

The molds which were constructed for these plastic mess trays were cut from 22 × 20 × 4-in. blocks of S.A.E. 4615 case-hardening steel. In order to minimize flash removal and finishing operations, it was decided to construct a positive type mold. The molds were steam channeled since the recommended molding temperatures for the material run from 20 to 30° higher than are generally used on other thermosetting plastics. This steam channeling of molds in which melamine parts are produced makes possible the use of temperature ranges up to 350° or higher, thus producing parts better and faster.

The design of the tray is well adapted to the use of melamine since the 30° tapers in the compartments practically eliminated the possibilities of undercuts in the mold, a particularly objectionable condition when melamine compounds are used, because their hardness sometimes causes parts to stick in the die. The most difficult work in building these molds was to

* Vice-president, Eclipse Moulding Products Co.

maintain accurately the radii in the compartments, so that trays made by the various molders could be neatly stacked and nested. Matching of the punches and cavities required considerable handwork to obtain the close tolerances required. Molds were also finished with a good polish in order to produce trays with a high luster.

Molding

These trays are compression molded on 500-ton semi-automatic presses. It was found that preheating the compound which had been compressed into preforms approximately the size of the tray, reduced the curing cycle. The material is preheated for about 8 min. at a temperature of approximately 180° F. This operation practically assures thoroughly cured parts which consistently pass the Quartermaster Corps Specifications concerning water absorption which is not to exceed 2.5 percent. Preformed and preheated charges can be cured in from 2 to $2^1/_2$ min., while bulk charges require a curing cycle of from 4 to 5 minutes. When molding bulk charges, a loading box with a sliding bottom is used. Molding temperatures which started at around 300° F. were increased during test runs, and it was finally determined that temperatures of 340 to 350° F. produce trays that satisfactorily pass all tests. In order to produce dense, thoroughly cured parts, pressures of 5000 to 6000 p.s.i. were found to be most practical. Because of the design of the part, no difficulty is experienced in removing the parts from the mold, but it was found necessary to use shrink fixtures in order to eliminate warpage. After the trays are removed from the mold they are placed in a simple wood clamping fixture for about 20 minutes. This process holds the tray flat during cooling and shrinking. After they have set, the trays do not lose their form even after alternate periods of immersion in boiling and cold water.

Tests

Although many requirements were established governing the inspection and tests of these trays, the most important concerned odor, resistance to boiling water, warpage and water absorption. The odor test is (*Please turn to page 172*)

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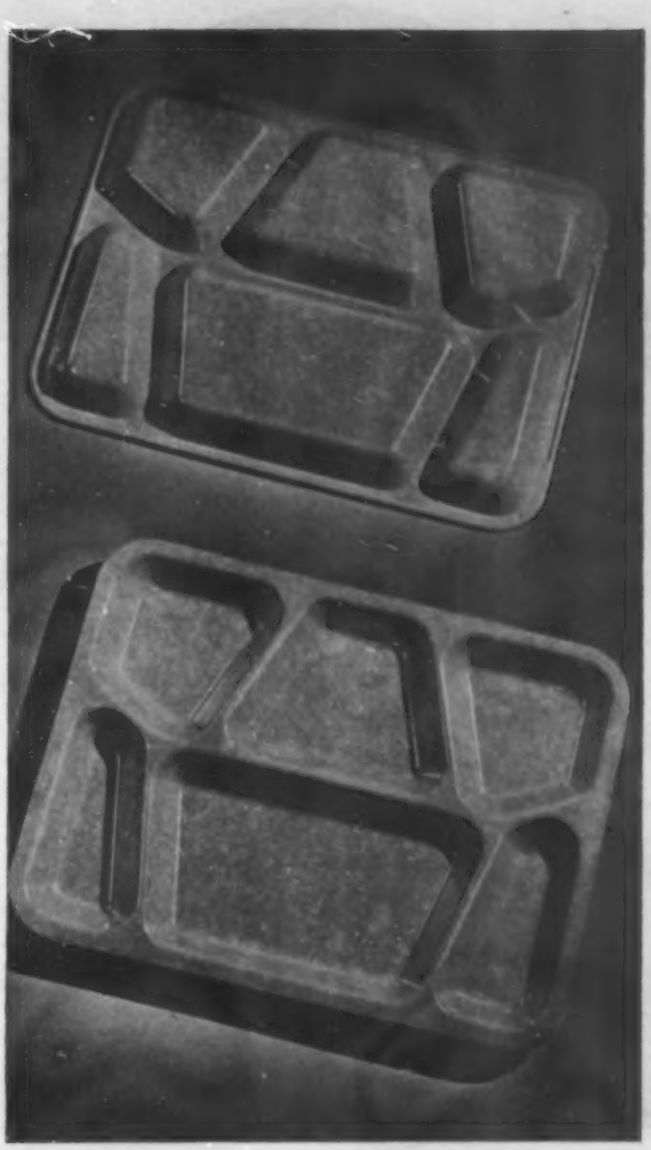

DRAWING, COURTESY ECLIPSE MOLDED PRODUCTS CO.

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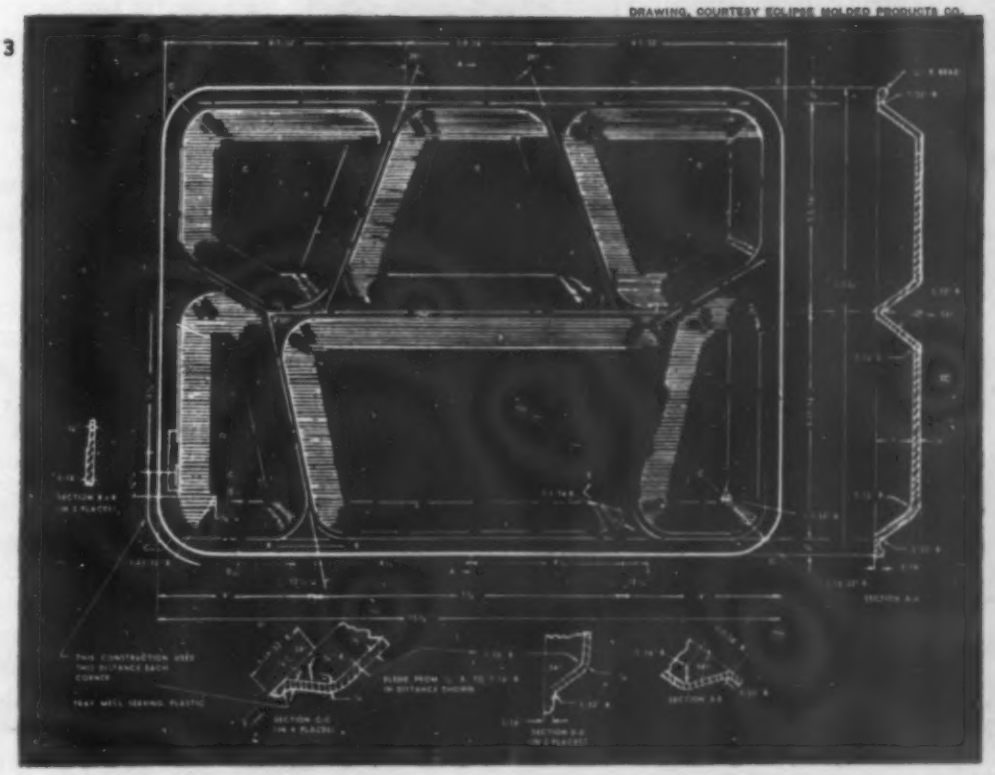
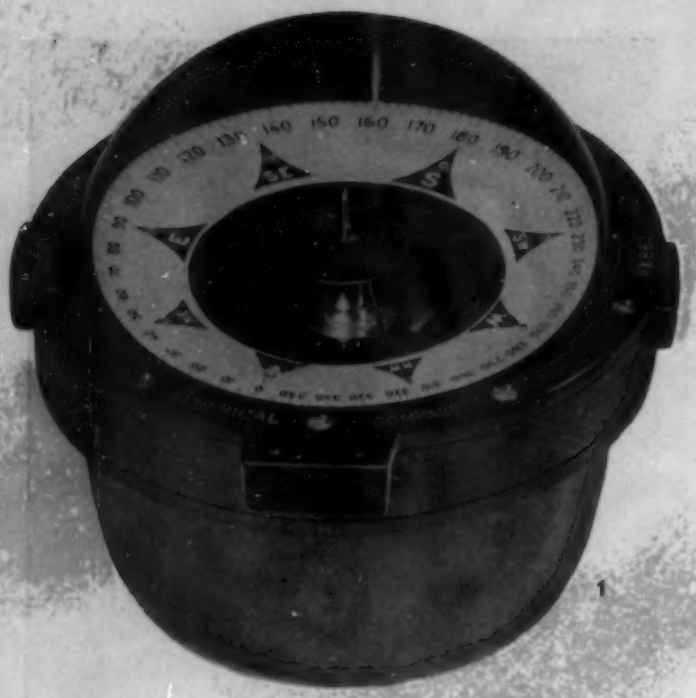


***2**—Back and front views of the mess tray show how the compartments are designed to accommodate any type of meal.* ***3**—This sectional diagram illustrates the 30° taper in the compartments. A 1/8 in. R beading enables the tray to fit into Army serving truck racks*



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PRODUCT

MAGNETIC COMPASSES (FIGS. 1 and 2), NECESSARY equipment of merchant ships and battleships, have joined the ranks of vital war materials daily being replaced by the development of new products in the plastics fields. Traditionally made of brass, the bowls of these compasses are now molded of a phenolic material which retains all the seaworthy qualities of the former: corrosion resistance and insensitivity to the salty atmosphere without or the alcohol-distilled water solution used to float the magnets within. More important, the phenolic bowl does not influence the instruments' delicate magnets.

The bowls, which are compression-molded in one piece, are almost 5 times as light as the original brass bowls. A brass top ring is assembled to each bowl by means of threaded screw inserts. The bottom of each bowl contains a molded-in metal insert to which is attached an expansion chamber. This copper unit acts as a diaphragm which expands and contracts with changes in temperature of the liquid in the compass. A plastic compass card to take the place of the mica card is another recent development.

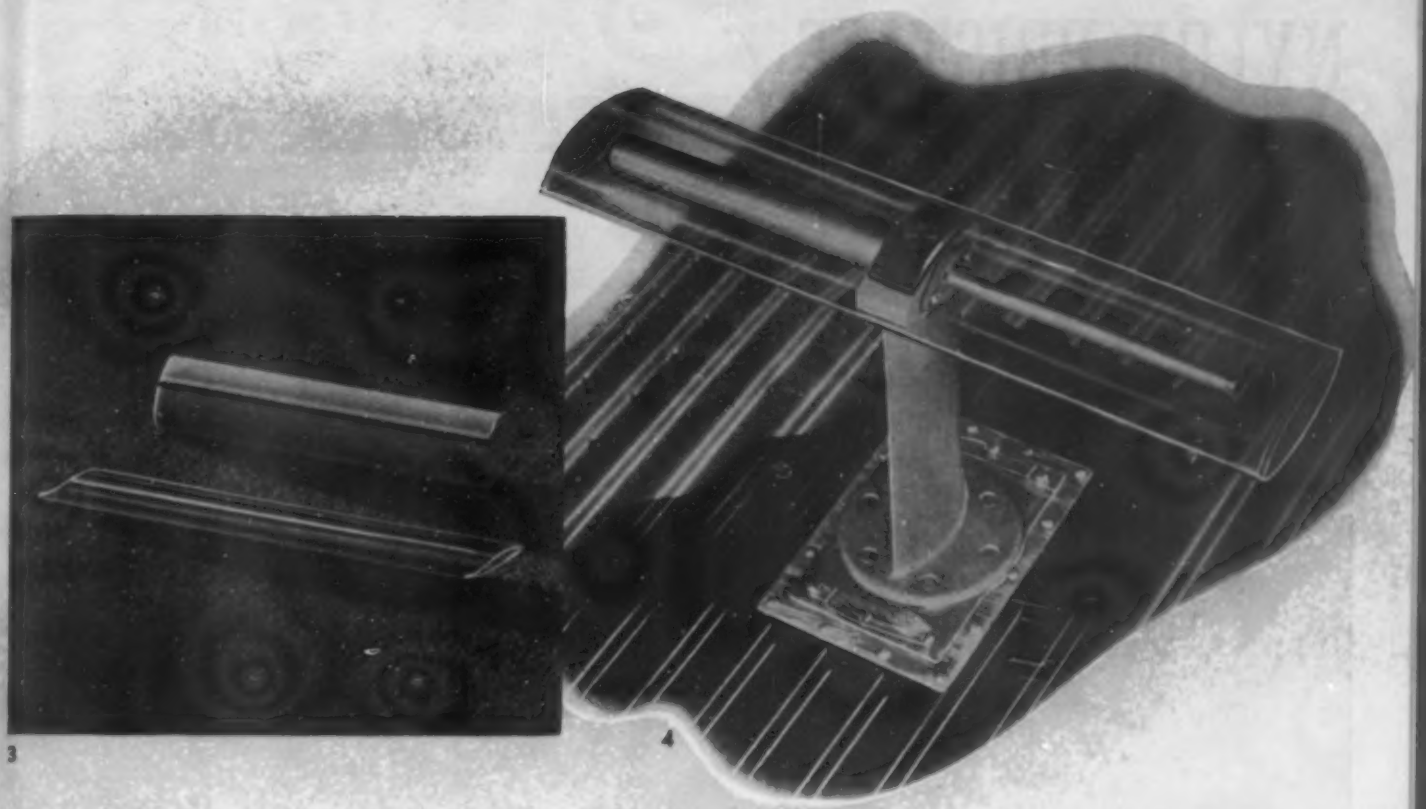
Credits—Material: Bakelite. Molded by Bay State Molding Co. for Kelvin-White Co.

A NEW METHOD FOR THE SIMULTANEOUS EXTRUsion of thermoplastic material in two or more colors (Fig. 3) has recently been perfected. Applicable either to rigid or to flexible tubing, as well as to moldings, the process has been found suitable for a number of uses in aircraft and marine work where the easy and positive identification of a complexity of wiring systems is essential. The color stripes are extruded from the same material as the body of the extrusion and are an integral part of it, thus eliminating any possibility of lack of uniformity in quality of the product. The molding or tubing, either opaque or transparent, can be extruded with any number of lines in any color or combination of colors, and has excellent insulating and non-oxidizing properties besides being highly resistant to acids, alkalies, oils and greases and to aging and constant exposure to light. It can be furnished in a variety of sizes, lengths, wall thicknesses and degrees of flexibility. Major aircraft companies are at present considering the possibilities of its use as a means of identifying hydraulic electrical hookups. Postwar plans for the utilization of this process suggest many civilian uses for the striped extrusions. For example, the production of decorative moldings for table edgings and trim, and the flat strips used in weaving seat covers for furniture, automobiles, buses and other public conveyances.

Credits—Material: Striatube, Striamold, extruded by Carter Products Corp.

AN ABSOLUTE ALTIMETER ANTENNA HOUSING (Fig. 4) is the current solution to the problem of eliminating night error, the effect of simultaneous voices and other disturbances in radio-directional apparatus on planes. Previous to the advent of aviation, mariners' height indicators were operated by barometric pressure and showed altitude above sea level only. With the discovery of a new travel medium—the airplane—the need for a more precise instrument showing altitude above terrain became imperative. The absolute altimeter antenna was the solution, but with its use came the additional problem of insuring its accuracy, since the position of the antenna on the under part of the wing exposed it to multitudinous disturbances.

The housing of the absolute altimeter antenna is composed of 2 pieces of methyl methacrylate about 18 in. long and 6 in. wide formed to a slight radius on the short dimension and ce-



3 4

DEVELOPMENT

mented together along the long edge. The two halves are formed to various semi-curvatures, and their edges cut on a chamfer so that a butt joint can be formed. For cementing, the halves were clamped in a jig to bring edges in close alignment. The housing, which in cross section resembles a pair of parentheses, is shatterproof and weatherproof, enables the pilot to proceed with full confidence in his altimeter.

Credits—Material: Plexiglas. Fabricated by Rohm and Haas Co. for Western Electric Co.

TRANSPARENT, CELLULOSE ACETATE WING TIPS (Figs. 5 and 6) now enclose colored navigation and identification lights on hard-hitting Douglas A-20 Havoc and Boston attack bombers. Night after night British and American four-engined bombers blast at Hitler's industrial centers. Since stragglers are easy prey for enemy interceptors, a cardinal principle of heavy bombardment is to fly in close-packed formation. However, this maneuver involves the danger of collision. In addition, night raiders must be able to tell within a matter of seconds whether an approaching plane is a friend or foe.

The colored navigation and identification signals which guard against these twin dangers are housed in a protective shield of transparent plastic. These enclosures which are formed to follow the normal contours of the wing are fabricated of heavy-gaged cellulose acetate which provides a smooth drag surface and wards off moisture, air pressure and the impact of glancing gunfire. Since the plastic unit is fastened to the metal tip with screws, it is easily removable when color combinations are changed or lights are serviced.

Credits—Material: Fibestos. Formed by Monsanto Chemical Co. Fabricated and assembled by Briggs Manufacturing Co. Designed by Douglas Aircraft Co.

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NYLON BRISTLES *for paint brushes**

by D. D. PAYNE†

OFFICIAL U. S. NAVY PHOTOGRAPH

1—These four sailors are busy painting the steel deck of the USS Richmond after it has been thoroughly cleaned

NYLON bristle in level or untapered diameters first was introduced to the public in 1938 through the toothbrush industry. More than a year prior to the introduction of nylon bristle for toiletware brushes, work was started to develop and perfect the process and machinery required for production of nylon bristle in tapered form. This is the type bristle necessary for the manufacture of paint brushes. Early in 1941 the Navy Bureau of Ships, mindful of the critical situation which might exist in obtaining an adequate supply of natural bristle if trouble should develop in the Pacific, became interested in the process. At that time, equipment was available to make only a few pounds of tapered nylon paint brush bristles per day, all of which were made into paint brushes for test purposes. Some of these brushes were submitted to the Navy Bureau of Ships and given a very thorough test at the Philadelphia Navy Yard. After several months of service, Navy reports stated that these paint brushes were entirely satisfactory.

Manufacturing facilities

When nylon paint brushes were approved by the Bureau of Ships, work was started immediately in cooperation with the U. S. Navy and the WPB, to design and install equipment for the manufacture of tapered nylon bristle on a somewhat larger scale. In order to obtain the high priority needed to secure materials necessary for the construction of this equipment, a contract was made to manufacture this bristle for the U. S. Navy on a very small scale. Since that time two plant-scale units have been designed, constructed and installed to manufacture tapered nylon paint brush bristle for the U. S. Navy. Based on forecast requirements of all of the armed forces for paint brush bristle, these two units have sufficient capacity to take care of these needs. Thus are we independent of any foreign source of supply for the natural brush bristle.

Comparison between natural and nylon bristles

Natural bristle, which comes from the skin of wild boars and is imported for the most part from the Far East, has a gradually reduced diameter from the butt end to the flag end. The splitting which occurs at the small end of natural bristle is called flag. Natural bristles are purchased by manufacturers of paint brushes in lengths varying by $^1/_4$-in. steps from $1^1/_2$ in. to 6 inches. High-grade paint and varnish brushes are made from bristle $3^1/_2$ in. to 5 in. in length. In the development of tapered nylon bristle for paint brushes, it has been possible not only to make this product in a tapered form with diameter varying from .012 in. at the butt to .007 in. at the small end, but also to produce it in $^1/_4$-in. variations in length from $3^1/_2$ in. to 5 inches. It also has been produced in a butt diameter of .009 in. and a tip diameter of .005 in. to insure a wider range of resiliency. Tapered nylon bristle also has been flagged to simulate the flag of natural bristle.

The manufacture of tapered nylon bristle for paint brushes is a mechanical operation in its entirety as is the manufacture of paint brushes from tapered nylon bristle, except that a chemical reaction takes place when the bristle is anchored in the paint brush. Tapered nylon bristle can be anchored or set in a paint brush using phenol-formaldehyde resin or some

* Presented at a joint meeting of the American Society of Mechanical Engineers and the Engineering Institute of Canada at Toronto, Oct. 1, 1943.

† Manager of Technical Service, Plastics Dept., E. I. du Pont de Nemours and Co., Inc.

of the conventional rubber compounds which are regularly used for this purpose. During the period of developing the process and machinery for producing tapered nylon bristle, all kinds of ingenious spinning devices were designed, tried, found wanting and discarded. Finally a taper was achieved by pulling a continuous nylon filament from a spinneret at a controlled variable speed. That is, the size of the filament varies with the speed of the pulling. A thick diameter results at slow speed and a thin diameter at fast speed.

Production problems

The next problem was to achive these results on a practical production basis. And when achieved, only one of the many problems was solved. Nylon filaments after being spun, must be drawn to several times their original length. This cold drawing gives them their strength and resiliency. To draw these tapered filaments to several times their original length without snapping their thinnest section is not easy. A number of filaments of tapered nylon are spun and drawn in a continuous operation. Keeping this operation in phase is one of the major mechanical problems. More months of labor and more research funds were given to this work than to any other before a satisfactory technic was developed and dependable mechanical equipment was designed for doing this work. The cutting of tapered nylon bristle to length from continuous filaments required the design and construction of special equipment. Tapered nylon bristles are delivered to brush manufacturers tied in neat bundles cut to the specified length within limits of $1/16$ inch.

Probably a better estimate of the mechanical problems encountered in the design and construction of this equipment can be made after considering what the equipment is required to do. Spinning of tapered nylon bristle is a melt extrusion without solvent, operated at extremely high temperature. Nylon in molten form is forced through a spinneret by an extremely accurate pump which had to be specially developed for this use. From this description, it can readily be seen that the manufacturing equipment operates under conditions which present many mechanical problems.

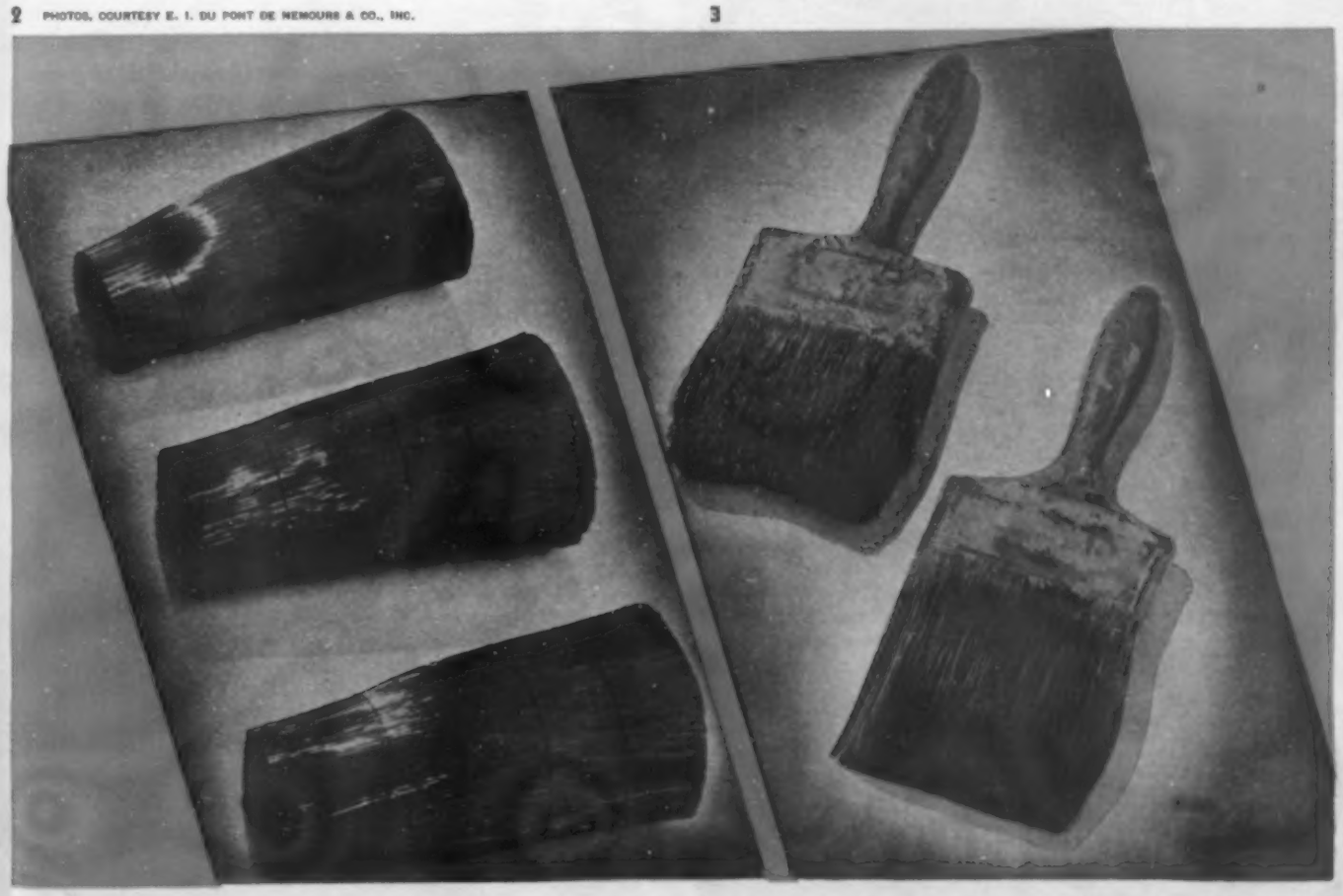
Everyone is well aware of the fact that nylon has gone to war. For some time prior to Pearl Harbor, the supply of nylon was critical when compared to the actual need of this product for very necessary war uses. Since that time the production of nylon has been stepped up. However, the critical need for this product has increased more rapidly than facilities have been expanded for its production. Today it appears that tapered nylon bristle for the manufacture of paint brushes will be available only for very essential war uses for the duration.

Conclusion

It is conservative to state that paint brushes made from tapered nylon bristle will last three times as long as similar brushes made from natural bristle. In addition to its longer wearing properties nylon is unaffected by any of the usual organic solvents used in the manufacture of paint, stains, lacquers, enamels, or those used for cleaning paint brushes. Nylon bristles are not affected by the alkalinity of calcimine nor are they attacked by moths, rats or mice—a serious problem in the storage of natural bristle and paint brushes made from natural bristle.

2—These three bundles of tapered nylon bristles show the form in which they are shipped to the brush manufacturers. **3**—*As a comparative test, both the hog-bristled brush at the left and the tapered nylon-bristled brush at the right were used to paint 32,000 sq. ft. of brick and concrete under similar conditions. The results are evident*

2 PHOTOS, COURTESY E. I. DU PONT DE NEMOURS & CO., INC. 3



PLASTICS IN REVIEW

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1 A recent addition to Chemical Warfare equipment is this anti-gas eyeshield stamped from transparent Fibestos. The 2 snaps at either end are locked to make a face-conforming protection against skin-burning or eye-affecting chemicals. The shields are manufactured by Foster Grant Co., National Transparent Box Co. and Royal Lace Manufacturing Co.

2 This life-saving kit which is a standard part of the Navy's signalling equipment on all life-rafts, contains a projector and a supply of red, white and green flares by means of which sailors adrift on a raft at night may signal their whereabouts to rescue ships. The inner transparent cannister is molded of Nixonite and the flare capsules from a solution of Hercules cellulose acetate flake. Both cannister and capsules are molded by Celluplastic Corp.

3 This compression-molded toilet seat of Durez contains no seams, joints or cracks to catch dirt or bacteria. Formed by Eclipse Molded Products, it comes in 2 styles for 2 types of bowls and is available in either black or brown

4 A plastic 4-ply tire suitable for a light car has recently passed its first 8000 miles of actual road tests. Formed from Plioflex, an elastic material developed by the Goodyear Research Laboratory, it is said to be the first of its type which can be vulcanized during molding operations. The material can be handled in hot molds exactly like natural rubber, using standard equipment. Road tests showed that the carcass and

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treads reached maximum temperatures only slightly higher than those for tires of natural rubber and much lower than were developed in synthetic rubber tires of some other types

5 Water tanks and wash basins of urea-bonded plywood perform a double function by saving needed aluminum and reducing the load on the Navy's non-rigid airships. Of simple design, the units are formed under heat and mechanical pressure by Goodyear Aircraft Corp.

6 Seabees take cover under this safety helmet of 8 oz. duck impregnated with Durez resin. Low-pressure molded by Paramount Rubber Co. under a patented process, the helmet weighs only 11 1/2 oz. but affords an impact resistance of 80 foot-pounds. The crown fits a wide range of sizes and allows space enough between suspension straps and the inside of the helmet to protect the head from concussion. The flexibility of the helmet is an additional guard against heavy weights

7 Housewives have a new task lightener in "Jack Pot," a scouring pad specially created for the cleaning of fine enamel, glassware and porcelain. Made of cotton processed by a solution of Casco resin the pad is waterproof and especially long lasting. The pad is said to do an efficient and quick cleaning job without scratching, splintering or rusting and without discoloring enamelware or porcelain

8 Hidden defects in military equipment are highlighted by these Lumarith inspection mirrors molded by B. W. Photo Utilities and distributed by F. P. Kretchmer. A sliding knob operates a small rod which adjusts the mirror to any required angle. The light weight and comfortable grip of this tool are a boon to busy defense workers for these characteristics considerably reduce fatigue

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Among the speakers at the convention were Dr. W. Gallay, B. B. McIntyre, R. Dickey, A. E. Byrne, F. W. Wentker and Wm. Cruse

Conference of Canadian Section SOCIETY *of the* PLASTICS INDUSTRY

"PLASTICS at War" was the keynote of the Second Annual Conference of the Canadian Section of the Society of Plastics Industry held on Jan. 25 at the Royal York Hotel in Toronto. Registration for this meeting totalled almost 300. The program was divided into two sessions, morning and afternoon, with a diversified panel of speakers representing both the Canadian and the United States plastics industry. The one-day conference concluded with a banquet at which B. K. Sandwell, distinguished journalist and editor of "Saturday Night," delivered an address on "Canada as a Peacemaker." A. E. Byrne acted as chairman of the morning session; Dr. W. Gallay, National Research Council, was the luncheon chairman; L. J. Falkenhagen, secretary-treasurer of S.P.I., Canadian Section, presided at the afternoon meeting; and George K. Scribner, S.P.I. president, acted as chairman at the banquet. General Chairman A. E. Byrne was assisted by a committee which included: C. Bewick, K. H. Braithwaite, A. W. Bennett, J. L. Burnie, M. W. Davidson, H. Flynn, C. C. Fuller, I. G. Goddard and I. Wintrob.

At the annual meeting of the Canadian Section, K. W. Braithwaite, Duplate of Canada, Ltd., was elected chairman; L. J. Falkenhagen, Jos. Stokes Rubber Co., Ltd., vice-chairman; and John Benedito, Canadian Resins and Chemicals, Ltd., secretary-treasurer. A feature of the conference was a special display of Canadian plastic products which was supplemented by a selection from the MODERN PLASTICS exhibit.

Chairman A. E. Byrne called the meeting to order at 10 a.m. and briefly told of the progress the Canadian Section had made since its inception a little over a year ago. After welcoming the U. S. members and speakers and expressing appreciation of their interest and cooperation in assisting his committee, he introduced G. Shaw of Plastics Div., Carbide and Chemical Corp., who spoke on "Applications of the Vinyl Resins in the Transportation Industry." The scope of this talk was limited to the vinyl resins to which elastic, rubber-like properties can be imparted by the addition of liquid plasticizers, usually of the ester type. Resins falling within this classification are vinyl butyral, vinyl chloride and vinyl chloride-acetate.

In tracing the history of the use of elastomeric vinyl resins in the transportation field, Mr. Shaw said that this material first was employed in 1936 as an interlayer for safety glass. The properties of these elastomeric vinyl chloride-acetate resins are such, Mr. Shaw continued, that they are in the unique position of competing directly with both plastics and with rubber. In the case of plastics where material costs are now essentially the same, flexible, injection-molded vinyl elastomers can add softness and resilience to customary molded knobs, steering wheels, etc., in interior trim. In the case of natural rubber, an initial material cost differential exists which must be offset by superior performance and lower fabricating costs on the part of vinyl chloride-acetate resin to justify its use.

Prior to the introduction of the vinyl chloride-acetate coated cloth, he continued, upholstery materials fell into three rough cost and performance classification—pyroxylin-coated fabrics, a rubber-base produce and real leather. Vinyl resins can be expected to compete in transportation with all 3 classifications. Another large-scale example of the application of vinyl chloride-acetate elastomers has been its use as a harness in transportation wiring.

At the start of the war, Mr. Shaw said, the applications already described were translated directly into combat vehicles and aircraft. However, as the rubber shortage became more

and more acute, an automotive group consisting of car manufacturer and plastic supplier took the initiative and successfully adapted secondary-grade vinyl chloride-acetate resin, then available to replace extruded and molded rubber parts.

In Mr. Shaw's opinion, the newness of flexible injection-molded vinyl chloride parts and the conditions under which they were introduced prevent accurate estimates of where the final economic balance will settle. Under present conditions when new mold and production costs are high, finished molded vinyl chloride-acetate parts are running two or three times as much as parts previously made in larger quantity using natural rubber. A differential of that order is not discouraging as mold and development costs on new injection molded vinyl parts must be amortized over a considerably smaller volume of production than that encountered in peacetime automotive output. Under present rubber practice wherein the stock must first be extruded and cut to preforms for compression molding, a rubber compound loss in the flash ranging from 5 to 30 percent is customary, the speaker stated, and a hand trimming operation for finishing rubber parts is necessary. Each of these steps is eliminated in the injection molding process for thermoplastics as the sprues and runners are re-usable and the finished part is molded directly from granular stock as supplied by the manufacturers.

According to Mr. Shaw, the postwar possibilities for vinyl chloride-acetate resins in the transportation field are attractive. New design modifications will be made possible for extruded window channels, gimp sections, etc. Having proved themselves functionally in combat in such places, it would seem logical to provide similar sections in smooth pastel shades which will blend in with interior and exterior colors.

In the field of coated fabrics, embossed vinyl chloride-acetate coated fabrics simulating leather have proved themselves economically and functionally, he said, and will replace a good part of the pyroxylin and rubber artificial leathers and real leather formerly used. Unique effects have been obtained by using transparent flexible coatings over very inexpensive fabrics and placing dependence on the fabric design and color to give the desired design effect.

Mr. Shaw expressed the opinion that the existing cloth coating industry seems to have sufficient capacity to handle coated fabrics. However, in the fields of molding and extrusion, standard rubber plant extrusion and molding equipment cannot be used satisfactorily to produce extruded and molded elastomeric vinyl chloride-acetate parts.

F. W. Wentker, Electronics Apparatus Div., R.C.A. Victor Co., second speaker on the program, mentioned in his talk on "High Frequency Heating in the Plastics Industry" that there already exists between the plastics and the electronics industries a relationship in which each is contributing to the success of the other. Electronic applications in our industrial and business life can be loosely grouped into a number of categories, he said. It has been and is being used for detection, for precise control of machines and processes, and as a means of extending man's senses through use of the Electron Microscope. In addition, electronics has for a long time been making extremely important contributions to industry in the way of communications—both wired and wireless—sound and radio. Finally, there is the application of high frequency power, i.e., power pulsating at frequencies in what is normally referred to as the radio frequency spectrum—frequencies which may be as high as hundreds of millions of cycles per second as contrasted with 60 cycles which is most commonly used for electric power distribution systems.

At this point, the speaker continued, it might be well to clear up one misconception on the part of many people not familiar with molding methods. It is often assumed that, because electronic power preheating is very rapid the difference in preheating is very rapid on produce output. Such is not the case because the press is not directly involved. Obviously all that counts is the saving in time from the point where the press is charged. Other advantages accruing from the use of the equipment is that the preheating causes most of the gases to be driven off before the preform is ever placed in the mold, and so gas problems can be practically forgotten. When a mold closes on a thoroughly softened preform, there obviously is little danger that delicate mold parts will be sheared off.

Another advantage which was made quite evident from the discussion, is the fact that with much improved flow properties, lower molding pressures suffice. This, among other things, means less strain on molds and presses and, therefore, lowered maintenance. And it points to the possibility of employing lighter cheaper presses and less expensive molds.

The size of the electronic power unit depends, he continued, upon the size of the job to be done. Maximum allowable preheating times have not yet been determined; common practice has been to play safe and allow a maximum time of one minute. Operating costs commonly cause many questions, Mr. Wentker said. A reasonable estimate is that molding material may be heated at an average cost of approximately one-tenth cent per lb., including equipment amortization and electron tube costs.

Recently a new design has been engineered to meet efficiently the specific needs of the plastics industry. Extreme attention to simplicity and ease of operation feature this unit, the speaker stated. The heating chamber is under the lid. One electrode retracts with the lids and the other is on an insulating pedestal. Electrode sizes can be changed quickly if a shift to a widely different preform is necessary. An automatic timer which includes a sweep hand is built into the unit.

Since the higher the operating frequency the more rapid can be the heating, this unit is made to operate at a frequency of approximately 27.4 megacycles, Mr. Wentker stated. For bigger preheat jobs than one pound charges, a bigger electronic power equipment is required. Electronic power preheating is being of real help in special cases involving the molding or forming of thermoplastic materials, as, for example, the molding of plastic lens. Perhaps, however, some of the most potent applications for electronic power in the field of thermoplastics concern the fabrication of thin thermoplastic sheets or materials which have been coated with a thermoplastic to make them resist transmission of air or moisture.

R. B. McIntyre, project engineer, De Havilland Aircraft Co. of Canada, Ltd., brought a buoyant note of optimism to the meeting with his semi-technical description of the design and production of the famous Mosquito aeroplane. This plywood aviation development was, he said, a somewhat unorthodox flying machine.

In an informal, good-natured manner Mr. McIntyre emphasized the tremendous value of plastic accessories in present aeroplane production. The most lucrative application of plastics in aviation in the future, he suggested, lay in the development of plastic materials suitable for the interior decoration and utility of aircraft for commercial postwar travel.

Dr. W. Gallay, National Research Council, Ottawa, chairman of the luncheon meeting, introduced Mr. James B. Neal, president, Norton Laboratories, the guest speaker. Mr. Neal, whose subject was "Twenty Years a Molder," first traced the history of his company from the time of its incorporation in 1915 until the present day. During the years between 1932 and 1940 the industry was moving ahead in great strides, the speaker noted. The growth was marked by new compounds: urea, methyl methacrylate, ethyl cellulose; the wide introduction of injection molding machines; the successful adaptation of cellulose acetate, transfer molding, and jet molding.

Turning to the problems which confront us for the future, the speaker said that within the last few weeks he had seen figures indicating that as soon as equipment was available, some 300 new units would enter the molding field in the United States, which at present already numbers some 800 molders. This will mean a 33 percent increase in competition. Only one result can come from this: the profit margin for most companies will be extremely narrow. Mr. Norton said that many companies seem to expect to increase their business after the war by putting

in plastics departments to produce products they previously had been forced to purchase outside. No doubt this is one type of business progress, but it isn't a fundamental solution. It is merely a shift in responsibility.

In future publicity Mr. Norton said that he believed that SPI should acquaint the industry with certain facts of life. First, that plastic materials are made by the large chemical companies and that although there is always room for one more manufacturer, the development, production and marketing of plastic materials is a costly operation. Second, that although large companies sell their product for all kinds of specialized purposes, the largest group they sell to are the molders. That this division of the business does not require a great amount of capital and consequently many people are lured to enter it, but that although this is highly desirable if they produce new articles, the more usual practice is to make the same product as that already being turned out by those engaged in the business. That since the newcomers have no background of experience from which to determine long-run costs, and since the easiest way to get started is by setting a low selling price, a vicious cycle is promoted which is destructive to the national aim of maintaining employment.

As we all know, many plants in the United States have expanded tremendously as a result of the war effort. Recent statistics which SPI has received from the 71 companies reporting sales show that the molders will have produced about $95,000,000 worth of merchandise during 1943. The Society estimates that since their report covers only 65 percent of the industry total, the overall 1943 volume would be around a hundred and forty-six million. This is splendid, but let us keep our feet on the ground. Let us remember that one metal company alone increased its sales from 1940 to 1942 by an amount equivalent to the total 1943 business of 71 molding companies.

When the afternoon session resumed, Mr. L. J. Falkenhagen acted as chairman and introduced R. R. Dickey, Monroe Auto Equipment Co., as the first of the 4 afternoon speakers. Mr. Dickey, speaking on "Metal Plating of Plastics," expressed the opinion that plating of plastics opens up even broader fields for plastics than ever existed previously. With plated plastics, he said, things can be done which cannot be done in any other economical manner. We are not imitating metal. We are doing something which cannot be done in metal and complicated shapes can be molded of plastics and plated which could not be fabricated in metals.

As everyone here knows, Mr. Dickey continued, one of our principal competitors after the war will be the light metals. So here is an application which is of particular interest since it has brought and will continue to bring a large volume of business into the plastics industry which, without metal plating of plastics, would have stayed in aluminum or magnesium. The speaker said that the metal plating of plastics eliminates costly inserts and assembly operations and results in a product which is lighter, more quickly manufactured and much more resistant to the terrific vibration which is set up in modern, combat-aircraft.

Just as in the case of industrial uses, Mr. Dickey said, the decorative uses are too numerous to list completely. Decorative costume jewelry combining the luster of metal, the beauty of colorful plastics and featherweight lightness is one big field. Uniform insignia and fraternal emblems are another field.

Molded automobile hardware, chrome plated, has attracted the interest of the entire automobile field in the United States. Often metal over plastic does a better job than metal over metal. The corrosion resistance of a metal coating deposited directly on a plastic base is far superior to that of an equivalent finish on metal. Electrolytic action between dissimilar metals is eliminated and the corrosion and spattering out which formerly occurred with a metal base are now non-existent.

As assistant professor of chemistry at McGill University, Dr. R. V. V. Nicholls, third speaker at the afternoon session, has served on the educational committee of the Canadian section and has done much to encourage technical advances in the Canadian plastics field during the past few years. He selected as his subject "Plastics from Wood and for Wood Improvement."

Plastics, rubbers and fibres, as well as adhesives and film-forming materials, whether naturally occurring or synthetically prepared, consist of macromolecules or long-molecules, Dr. Nicholls stated. Wood is an excellent source of macromolecules or of materials which can be converted into macromolecules.

He listed the essential constituents of wood as cellulose, hemicellulose, lignin, tannins and, to a lesser degree, resins, terpenes, fats and sterols. Cellulose is macromolecular and, by virtue of its fibrous nature, is ideally suited as a material of construction for the tree. In an analogous fashion, wood flour and wood pulp in various forms are widely used as fillers for plastics. Dr. Nicholls also discussed the newer techniques of resin-pulp molding and resin blanks. Cellulose is not moldable but can be rendered thermoplastic by conversion into its esters or ethers. Cellulose esters and ethers hold a pre-eminent position among the "thermoplastics." The botanical function of the hemicelluloses is not known but they are macromolecules of medium chain length with reactive hydroxyl and carboxyl groups and would appear to be suited for conversion into plastics.

Lignin is the principal binding material of wood. It is thermoplastic though somewhat lacking in flow. In recent years a great deal of attention has been given to the potentialities of lignin as a plastic, especially by paper companies who obtain lignin in modified form as alkali lignin, a by-product of the soda process of paper manufacture, and as lignin sulfonic acid, as a by-product of the sulfite process. Being both aldehydic and phenolic in character, lignin would appear to be suited as an extender for the phenolic resins which are in short supply. Lignin-enriched fillers find use. Tannins are phenolic substances, also, occurring especially in the bark of such trees as the Pacific Coast redwood. They have been found useful in increasing the moldability of the wood. The botanical function of wood resins appears to be as film-formers, to seal off the plant when wounded and so protect it from the inroads of bacteria. The terpenes are volatile solvents for the resins. The industrial applications of these materials strictly parallel their botanical function, the resins being useful as film-formers in paints and as plasticizers in plastics. The terpenes are not macromolecular but can be converted into macromolecules (rubbers) through the isoprene-route. Both resins and terpenes can be obtained from the tapping of trees, from stumps, and as by-products of the paper industry. The botanical function of the fats and the sterols is not known, but they occur among the major constituents of tall oil, a by-product of Kraft paper manufacture and would seem to have potentialities for conversion into drying oils and waxes.

Morris Sanders, architect and industrial designer, in speaking on the "Development of Postwar Plastics Products" discussed postwar markets in a general way. He underlined the advantages of an industry-sponsored study of materials and manufacturing methods with relation to construction, home furnishings and all other consumer and industrial fields. Also he emphasized the importance of more closely relating materials and efforts to the real needs and tastes of the people.

Looking toward the end of the war, Mr. Sanders continued, everyone agrees on the one point that the lever of peacetime security must rest against one fulcrum of paramount importance —the home. At present, housing conditions are bad in both our countries. American experts foresee the construction of ten or more million dwellings in the United States during the decade following the war and the Canadian Minister of Labor, the Honorable Humphrey Mitchell, has predicted the construction of at least a million in Canada. When authorities speak of millions of homes, they usually think in terms of dwellings that can sell for $3000 or $4000 and still reflect our solid technological advances. Our economists have discovered that every home-building dollar is invariably matched by at least an equivalent dollar for complementary commercial and community con-

struction. They foresee, then, an annual building expenditure in the United States of about 9 billions of dollars.

The speaker also expressed the opinion that alterations and repairs will also move ahead rapidly when peace comes. In one prewar survey in the United States it was discovered that 18 percent of all shelter was in desperate need of major repair, that more than 45 percent lacked baths, that 22 percent had neither gas nor electricity. It was clearly shown that 31 percent of our people lived in homes which were distinctly substandard. Years of wartime neglect have seen that percentage mount, along with savings and a reasonable hunger for home.

This hunger will be reflected, for instance, in a demand for better home furnishings—a term which covers not only furniture and appliances but fabrics and kitchen utensils, wall coverings and lamps. Plastics have always performed well in the appliance fields and will certainly figure more importantly there hereafter. Plastic materials can also play prominent roles in other volume fields which they have only nibbled at before—as in furniture and hardware of all kinds, lamps, tableware, blinds, fabrics, protective undersurfacings.

Plastics entered the building field a long way back, Mr. Sanders said. Although their chief service there, as binders and coatings, has been directly profitable to only a small segment of the industry, it will eventually prove of great indirect profit to all. The bonding of plywood and plypapers has brought on the accelerated development of drywall construction, a form of building that clearly encourages the use of more plastics in the form of moldings, wall and floor coverings, molded hardware and lightweight, resilient fixtures and appointments of all kinds. When the war broke out, resin-bonded plywood was booming; when peace comes, that boom will continue. Furthermore, a host of new molded, extruded and laminated products will be ready to complement drywall construction.

In the hands of those who are poorly informed, Mr. Sanders warned, the very virtues of plastics become evils. Extreme ranges of color, clarity and physical characteristics frequently confuse architects and designers, to say nothing of merchandisers and public. Many of the companies within the SPI are approaching this problem in a sensible manner. This is especially true of the larger materials manufacturers, who retain market analysts and design and product development specialists to guide their customers and themselves.

The final speaker on the program was C. J. Romieux, sales manager, of the American Cyanamid Co., who delivered the second paper on plastic materials. He referred to the rapid growth in the use of resins produced from melamine as an outstanding example of how the science of chemistry and the chemical industry have contributed to the spectacular progress of the plastics industry.

Following this introduction Mr. Romieux said that instead of presenting an abstract list of chemical, mechanical and electrical properties of this resin, he intended to show a diversity of articles into which the resin has been incorporated and to which it has imparted specific properties.

One of these is electrical equipment, he continued, which in time of war must operate under service conditions which are far more severe than those normally encountered. Melamine resin in its cured form will not continue to burn after the source of heat has been removed nor is it readily carbonized under the influence of the electric arc. Combined with these special properties, it is a good insulator. The discovery that melamine resins will cure in contact with heat-resistant inorganic fillers such as asbestos, glass and silica has resulted in the use of asbestos-filled molding compounds to replace hard rubber and other plastics in aircraft ignition systems.

Prior to the war, melamine resins were used extensively in paper laminates to impart hardness, scratch-resistance, color stability, heat-proofness and protection against the action of cleaning agents, the speaker continued. At that time these laminates were used for bright-colored table tops. A similar technique is now utilized in the production of name plates, translucent instrument panels and permanently mounted instructions and diagrams for servicing military equipment. Undoubtedly the improved heat resistance of melamine laminates will expand the use of such products in the lighting field and improved weathering resistance will permit their postwar use for exterior applications.

Other prewar applications contributing to the war effort include the use of molding compositions formed in combination with alpha cellulose for wash buttons. This material was also employed for hard-stain-resistant tableware. At present the military services have taken over the supply of melamine buttons for wash garments and molded tableware is being utilized by the Navy for overseas stations, light vessels and aircraft. Recently a number of manufacturers have been producing compartment mess trays molded from a medium impact, fabric-filled melamine composition.

A more recent application for melamine resin has been in hot-set waterproof glues for plywood and laminated wood. Here the outstanding characteristic is the strength of the glue line under tension and in shear, combined with a water resistance which far surpasses the requirements for aircraft plywood. Melamine-modified urea resin glues have also been developed for hot-press plywood assembly, providing a bond which fails only at a high loading and which exhibits 100 percent wood failure in both shear and tension breaks.

The incorporation of about 3 percent of a melamine resin acid colloid in the preparation of paper stock does not appreciably affect the absorptivity of the paper, but whereas the untreated paper scarcely holds together when wet, that containing melamine resin has nearly as great strength wet as dry. The melamine resin also greatly improves the wet-rub resistance of the paper. The addition of this resin has not embrittled the paper but has actually improved its dry tensile strength and increased many-fold its capacity to be repeated folded without fracture. Paper so treated has been used for toweling, blueprints, maps, heavy duty packaging and currency.

Mr. Romieux pointed out that these resins have also been used in water solutions to render textiles creaseproof, to increase their resiliency, to produce washable semi-permanent glazed chintz and shrinkproof cotton, rayon and woolen fabrics, to stiffen mosquito and camouflage nettings and as hardening agents modifying polyvinyl butyral and other elastomers in impermeable coatings.

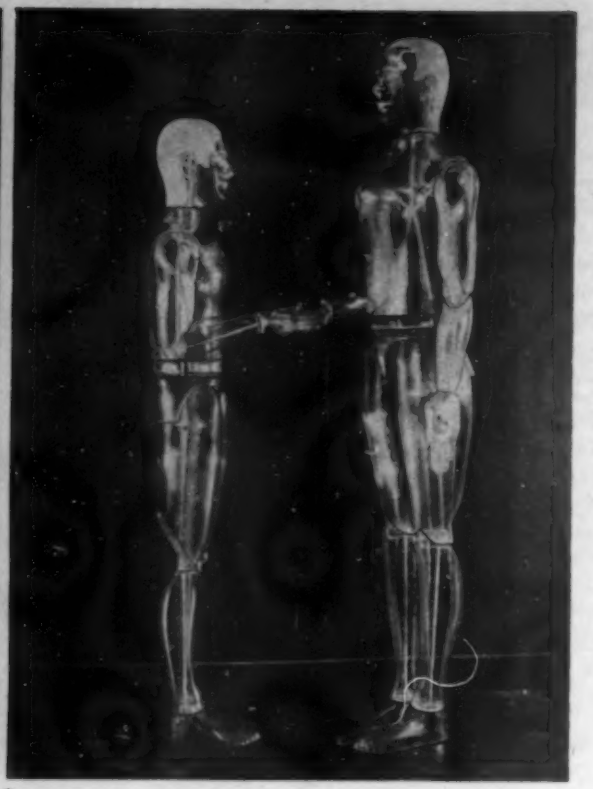
Particularly before the war, alkylanated melamine resins were widely employed as components of baking enamels for finishing automobiles, refrigerators, bathroom and kitchen cabinets, washing machines and many other metal appliances. In the postwar period it is anticipated that the volume of this application will greatly increase.

About 300 persons attended the final banquet. At the head table the chairman, G. K. Scribner, was accompanied by B. K. Sandwell, the guest speaker; Edward Sterne, Chemicals Controller, Department of Munitions and Supply; and other distinguished guests including the newly elected chairman, K. W. Braithwaite and his associates. At the conclusion of the dinner Mr. Scribner paid tribute to the fine achievement of the SPI, Canadian Section, in staging its second annual conference. He then introduced Ed Sterne, the Canadian chemicals controller. Referring to the controls invoked on the plastics industry in Canada, Controller Sterne declared that "denial is forced upon us. We will distribute supplies without fear or favor."

Moving swiftly into the theme of his address, "Canada as a Peacemaker," Mr. Sandwell outlined the growing importance of Canada in world affairs, and gave his audience a clear insight into the problems facing the Allied nations, particularly the U. S. and Canada at the peace table. His profound talk, spiced with political witticisms, proved to be a most impressive conclusion to a highly successful conference.

1

OFFICIAL PHOTOS, U. S. ARMY AIR FORCES



2

1—Three transparent manikins that represent a scientific average of the Army Air Forces' tallest, shortest and medium cadets, are used as standard yardsticks in all plane designs at Wright Field. Slim (seated) represents the tall 5 percent; Roger (standing) the medium 90 percent. 2—Slim and Shorty—the tall 5 percent and the short 5 percent of the AAF—help to solve problems of adjustable pilot seats, location of instruments, height clearance and passageway measurements

A trio of typical airmen

ARMY Air Force engineers now are fitting airplanes to the men who fly them. While aerodynamic pattern comes first, no longer are the tall men and the short men completely ignored and made to suffer inconvenient or cramped planning in turrets, cockpits, emergency doors and passageways. "Slim," "Shorty" and "Roger," three cellulose acetate manikins that represent average-sized pilots in the tall, short and medium classifications, now are influencing design of aircraft installations. Turrets, for example, have been modified in the last 3 months upon the recommendation of "human engineers" who fathered the manikins in the Wright Field Aero-Medical Research Laboratory, so as to give air crew gunners more room for effective operation. The trio are being used to solve problems of adjustable pilot seats, location of instruments where any pilot can see them, and proper placement of controls so that they can be operated with equal ease by both short-armed and long-armed men. The manikins are aiding in the correct installation of hundreds of equipment items which involve proper eye level, adequate elbow room, height clearance, passageways and seats of serviceable width, knee room and cockpit roominess.

Before Slim, Shorty and Roger were created, aircraft designers used outmoded statistics and "typical guys" working around the shop. However, it was discovered that this method of measurement left too much room for human error, and the so-called "typical guys" turned out to be not-so-typical. As a result, in 1940 Col. O. O. Benson, then Aero-Medical Laboratory chief, laid the groundwork for the creation of the three manikins. To insure that the figures accurately represented the long, medium and short types of Air Force men, a total of 2960 aviation cadets at Kelly and Maxwell Fields were measured. During this research dimensions of various shaped heads also were tabulated to assist in the design of properly fitting oxygen masks. Upon completion of the investigation and research, the three average-sized pilots were defined and head shapes minimized to seven typical forms representing 98 percent of the men in the Air Forces. "Slim" represents the tall 5 percent of our pilots who average 6 ft. $1^1/_2$ in. and weigh 172 lb. "Shorty" depicts the short 5 percent who are 5 ft. $5^1/_2$ in. and weigh 140 lb. The remaining 90 percent who average 5 ft. 9.2 in. and 154 lb., are represented by "Roger."

One of the most difficult problems involved in the creation of these manikins was the choice of material. It was essential that the material be thick enough to allow for a minimum shrinkage over a considerable period of time and be rigid enough to withstand handling. In addition, in order to fulfill their purpose, the models had to be flexible and light of weight. A solution was found in the use of two cellulose acetate sheets held together by cellulose acetate cement.

With the specifications decided upon, a sculptor and plastic designer were engaged to make models of heads and to produce the three basic body types that included a majority of the measurements. The statues were (*Please turn to page 170*)

The spreader method for the manufacture of compregnated wood

by HERBERT W. MACKINNEY and LEONARD REPSHER*

COMPREGNATED wood has become a highly strategic structural material because, to a rare extent, it combines lightness with strength. Also called "high density plywood," "resin densified wood" or "compreg," it has found an important use in one of the most highly stressed of military structures—the aircraft propeller—where it competes successfully with metals.[1]

Compreg is a laminated structure consisting of an assembly of wood veneers impregnated with a synthetic resin and converted under the influence of heat and pressure into a solid mass. Some thermoplastic resins have been used as impregnants but in general the thermosetting types, particularly the phenolics, have been found superior. These resins are converted during the pressing operation from the liquid or fusible state into the infusible form, and they impart to the compreg some of its most valued properties.

* Research and Development Laboratories, Bakelite Corp.

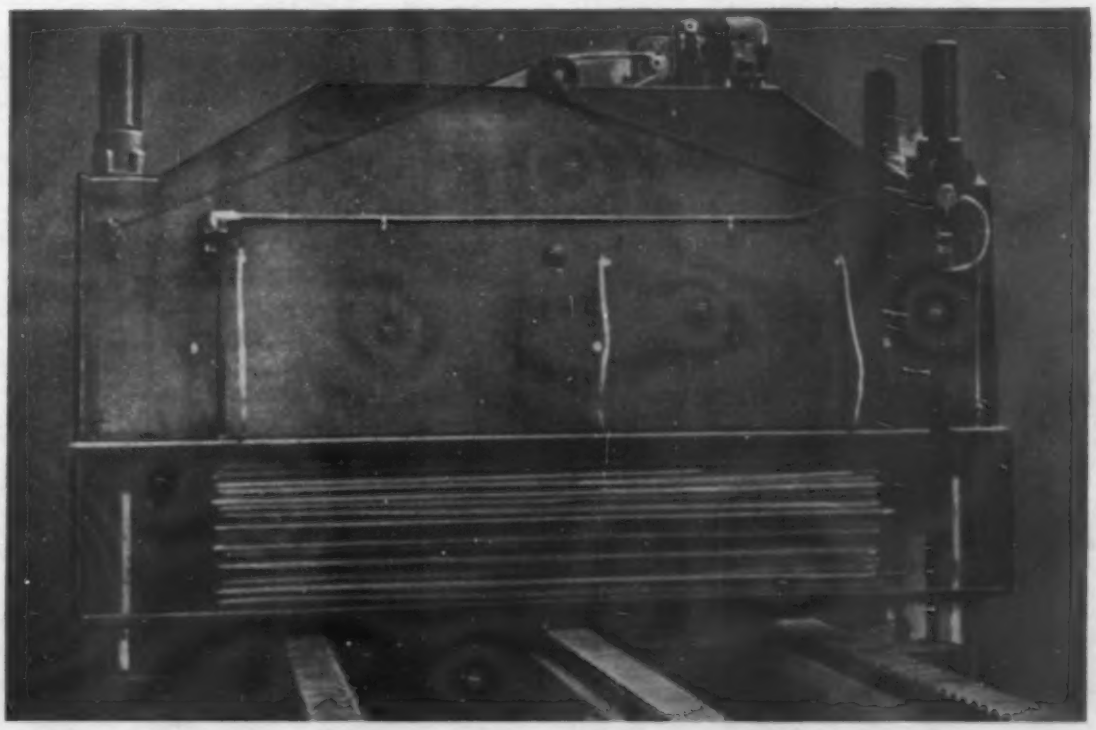
[1] G. W. Brady, Aero Digest *39*, 207–8, 210, 212 (1941). A. E. L. Jervis, Plastics *7*, 122–127 (1943). Thomas D. Perry, "Modern Plywood," Pitman Publishing Co. pp. 195–213. A. J. Stamm, MODERN PLASTICS *21*, 97–99 (Dec. 1943). A. J. Stamm, and R. M. Seborg, Trans. Amer. Inst. Chem. Engineers *37*, 385–398 (1941).

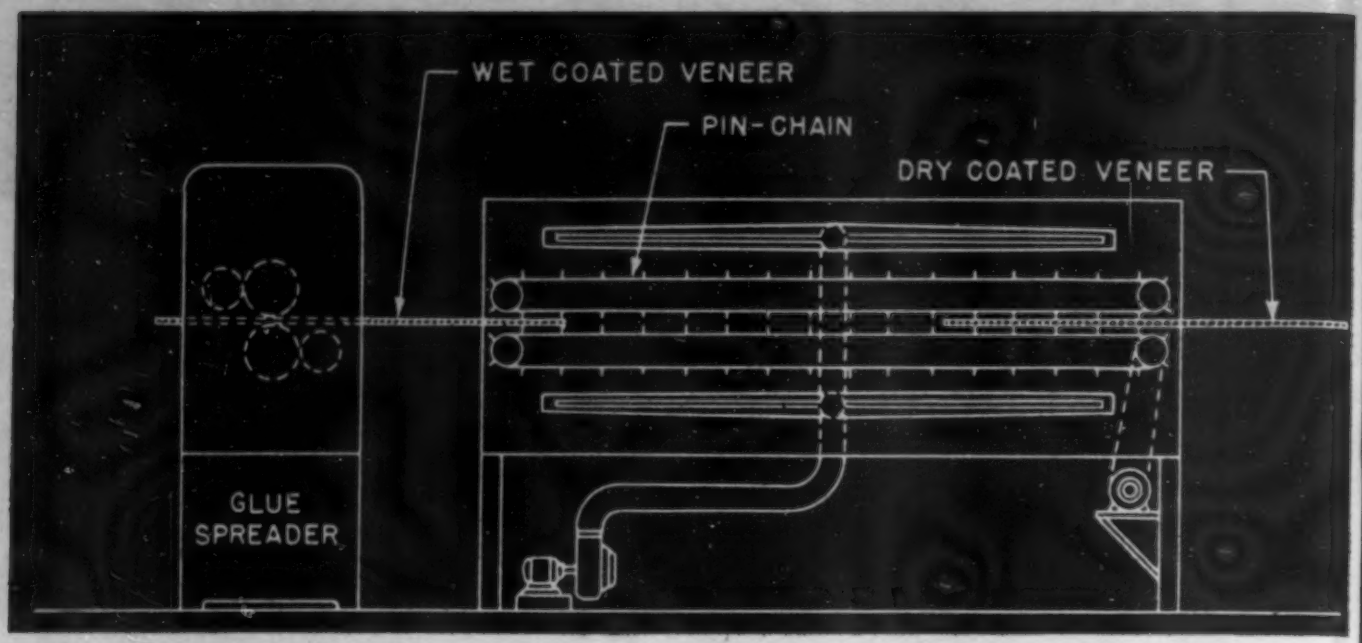
Properties of compreg

Compared with wood, compreg has markedly superior properties. It has great strength and resistance to fire and moisture, attack by insects, bacteria, molds and marine growths. It is not difficult to work and may be handled successfully by trained woodworkers. It has good thermal and electrical insulating properties and pleasing appearance. When suitably made, it has a high degree of dimensional stability and good resistance to corrosive atmospheres. The tensile and compressive strength properties are in the main a function of the specific gravity, which may reach 1.4. Resistance to moisture and thickness regain under high humidity depend on type and content of the phenolic resin and on the thoroughness with which the individual laminations are impregnated.

Stamm[1] distinguishes between two types of compreg:

1—This press is typical of that used in the manufacture of plywood





2—*This blueprint shows the equipment which is used for the "spreader" method in which the veneers are coated with a liquid resin and then dried, in one continuous method*

the "European" type, in which the impregnating resin is prepolymerized to a considerable extent and is applied in solution in alcohol; and the "Forest Products Laboratory" type in which the resin, at substantially the phenol-alcohol stage of condensation, is applied in aqueous solution. The former lacks dimensional stability, since the resin does not penetrate into the cell walls. In the latter, the smaller and more highly polar resin molecules penetrate into the cell walls, and they are thought by Stamm to combine at least loosely with the cellulose, resulting in a stable but more brittle structure.

Widespread civilian use of compreg commensurable with its superior properties has been deterred by the high cost of manufacture. A grade lacking in dimensional stability has been made by a simple procedure, but to gain satisfactory dimensional stability a long process has been required. In particular, the veneers must be impregnated with a dilute solution of the resin in water or aqueous alcohol. The swollen veneers must then, before compression, be redried to a low moisture content. Otherwise the compreg would warp, check and craze on standing.

Some quite recent experiments have shown that high-grade compreg may be made by a new technique in which impregnation of the veneers and compression of the assembly occur simultaneously. In this "spreader method," the resin is applied to the veneers as a surface coating on the conventional glue spreader. The resin is then forced into the wood during compression. The wood may be conditioned to a desired moisture content before coating, or redried and conditioned following the coating operation. This latter is of a noncritical nature and may be accomplished very rapidly since the veneers are not swollen by the resin mixture and most of the moisture which is removed is taken from the resin coating.

Comparison of compregs made by old and new methods

Comparative data on the properties of compregs made by several methods are shown in Tables I and II. The experi-

TABLE I.—TYPICAL PREPARATION AND PROPERTIES OF COMPREGNATED WOOD (PARALLEL-GRAIN LAMINATES)

Sample No.	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Type of Bakelite resin	*BV-10678*	*BR-15100*	*BR-15100*	*BR-15100 XC-16529[a]*	*BR-15100 XC-16529[a]*	*BR-15100 XC-16529[a]*	*XR-16632*	*XR-16632*	*BR-1500 [c] XC-16529 Cross-ply[b]*
Method of resin application	Impregnation	Impregnation	Impregnation	Spread	Spread	Spread	Spread	Spread	Spread
Wood species	Maple	Birch	Birch	Maple	Birch	Birch	Birch	Birch	Fir[b]
Veneer thickness, in.	0.125	0.063	0.125	0.04	0.063	0.05	0.063	0.05	0.1
Resin content, percent	22	20	30	25	20	15	9.5	25	12
Panel thickness, in.	1.4	0.5	0.5	1.3	0.5	0.5	0.5	0.7	1.4
Volatiles at pressing, percent	1.0	2.0	4.0	4.0	4.4	9.9	8.5	2.0	7.5
Compression temp., ° F.[c]	310	285	285	290	320	320	320	285	290
Compression pressure, p.s.i.	2800	1000	1000	3000	1600	2000	2000	900	1000
Specific gravity	1.35	1.39	1.39	1.37	1.36	1.38	1.33	0.99	1.26
Modulus of rupture, p.s.i.	39,400	44,000	42,500	48,000	49,000	....	....	....	22,000[b]
Modulus of elasticity in bending, 10^6 p.s.i.	3.3	4.4	3.9	4.5	4.3	....	....	....	....
Impact strength (Izod), ft.-lb./in.	8.6	7.2	4.0	8.1	10.0	6.0	7.4	13.1	6.0
Compressive strength, p.s.i.	28,700	26,000	....	28,000	28,500	....	25,000	....	....
Shear strength, parallel to grain									
Perp. laminae, 0.375 in. cyl., p.s.i.	10,500	6500	....	8100	8700	10,600	15,000	....	....
Par. laminae, 0.375 in. cyl., p.s.i.	5640	4300	....	....	....	....	3800	....	2000[d]
Single offset block	4630	4000	3900	4520	3100	....	....	....	....
Water absorption, cold water[e]	4.5	1.5	0.9	2.5	4.5	3.5	11	29	7

[a] Formula: BR-15100, 4 parts; XC-16529, 1 part. [b] Alternate cross-ply assembly.
[c] Cure cycle: 40 min. after center reaches 270° F. [d] 45° to grain.
[e] Weight absorbed in 24 hr. by cross-grain piece 3 × 1 × 1/8 in. after drying 24 hr. at 50° C.

TABLE II.—COMPARATIVE HARDNESS OF COMPREG

Sample No. (Table I)	*Wood*	*Resin content*	*Specific gravity*	*Rockwell hardness*
7	Birch	25	1.00	R83
8	Birch	25	1.35	R125
9	Fir	12	1.25	R100
..	Birch	0	0.65	R5

mental materials mentioned in the tables were made as follows:

(*a*) *Resin applied to wood by impregnation in solution*

Sample 1. Maple veneers, 1/8 in. thick, were impregnated with a solution of resin BV-10678, a medium-bodied phenolic resin, in aqueous alcohol. The veneers, separated to permit circulation, were redried, first at 140° F. and then at 240° F., to 0.5 percent volatile content and then assembled parallel grain before compression.

Sample 2. Birch veneers, 1/16 in. thick, were impregnated by application of air pressure to saturation with an aqueous solution of resin BR-15100, a type of resin in an early stage of condensation, and dried at 140° F. before reassembly and compression.

Sample 3. Made similarly to Sample 2 from veneers 1/8 in. thick.

(*b*) *Resin applied to wood by coating on glue spreader*

Sample 4. Maple veneers 1/25 in. thick were coated with resin BR-15100 and subsequently with an aqueous-alcoholic solution of resin XC-16529, powdered phenolic bonding resin, dried rapidly to 4 percent volatiles between coats. Proportion of resins, solids basis, 3:1. Assembly: parallel grain.

Sample 5. Birch veneers, 1/16 in. thick, were coated with a mixture of resin BR-15100, 4 parts, and resin XC-16529, 1 part, giving a ratio of resin solids of approximately 3:1. The veneers were redried at 140° F. before parallel grain assembly and compression.

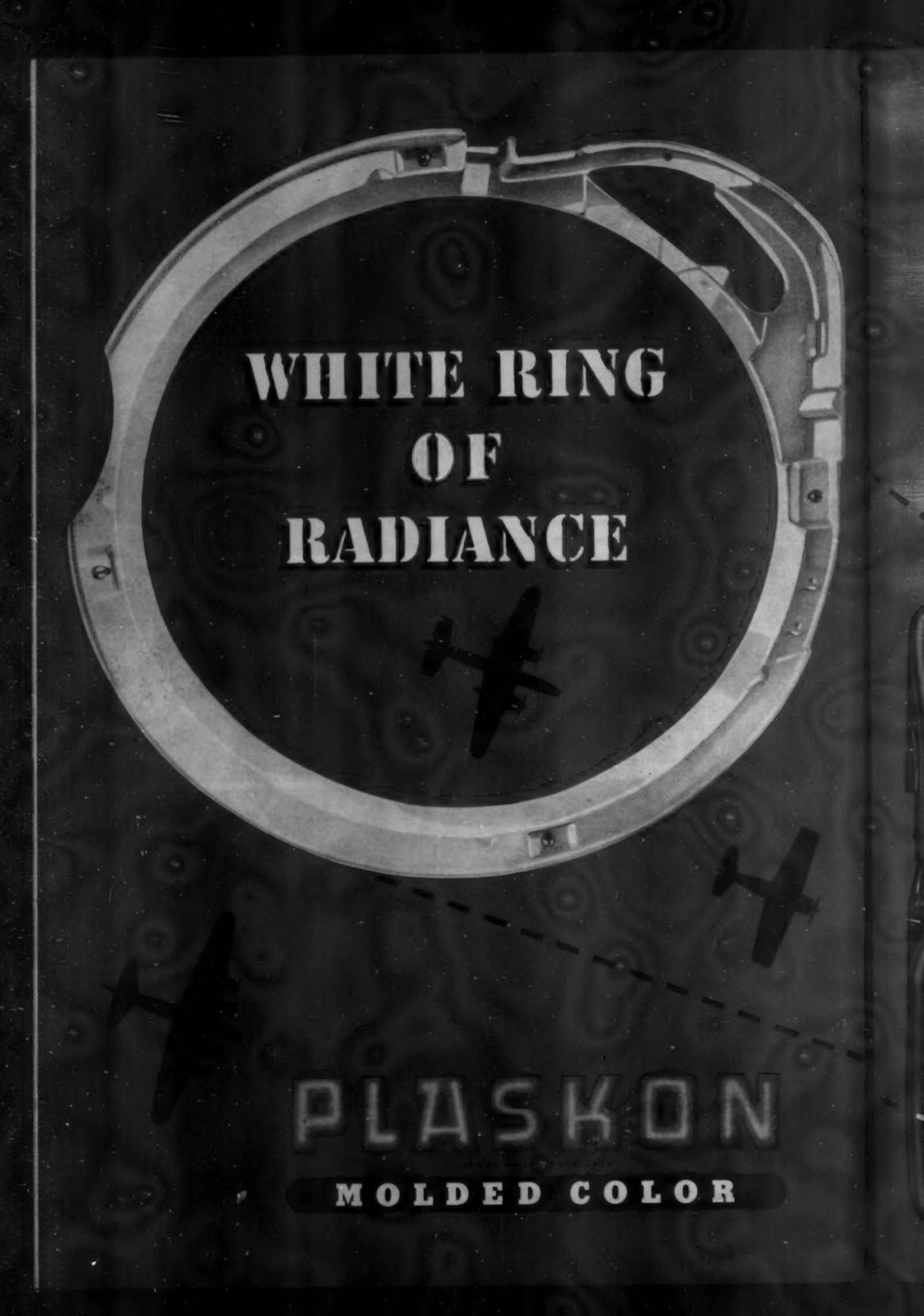
Sample 6. Made similarly to Sample 5 from veneer 1/20 in. in thickness, coated on one side only.

Samples 7 and 8. Resin XR-16632 is a highly prepolymerized liquid phenolic resin which enters only the larger cavities of the wood. Sample 8, having a specific gravity of 1.0, has exceptionally high impact resistance and suggests possibilities in replacement of imported dense woods like teak.

Sample 9. A cross-ply panel, made from unselected Douglas fir, 1/10 in. in nominal thickness, coated on one side with the resin mixture and not redried before compression.

One feature of the new method is disadvantageous—homogeneous, uniformly water-resistant material can be made from dense hardwoods such as maple or birch, usually specified for propellers, only if thin veneers, 1/25 to 1/20 (maximum 1/16) in. in thickness, are used. Veneers up to 1/8 in. may be used in the older method. However, this minor disadvantage may be offset by greater simplicity. (*Please turn to page 166*)

In these photographs the compreg samples have been enlarged to 4 times their normal size. 3—One-eighth in. maple impregnated with BV-10678; resin content 25 percent; veneer impregnated and dried before pressing, specific gravity 1.35. 4—One-eighth in. birch saturated with BR-15100; resin content 25 percent; dried and pressed; specific gravity 1.39. 5—One-twentieth in. birch spread with 4 parts of BR-15100 and 1 part of XC-16529; resin content 30 percent; dried and pressed; specific gravity 1.38. 6 and 7—One-twentieth in. birch spread with XR-16632; resin content 25 percent; dried to moisture content of 1 percent and then pressed; specific gravity 0.99


WHITE RING
OF
RADIANCE
PLASKON
MOLDED COLOR

With this precision instrument, the Army and Navy measure stresses and strains in aircraft of all types. Faster, more powerful, more deadly combat craft are assured for our Armed Forces through the developments which are proved by this device.

The bezel, or white plastic ring around the inside of the door on the instrument below, is molded of Plaskon. This Plaskon bezel gathers and reflects light from inside and outside illumination, making the chart and record more clearly visible and accurately read at all times. The ring also serves to keep the chart absolutely flat and level when the door is closed.

This is one of the many efficient wartime services of Plaskon. Because of its versatility, Plaskon has aided in the development and manufacture of important products for the battle front and home front. It is a strong, non-shattering material, with a smooth surface, and is available in a complete range of colors. It is unaffected by oils, fats, or common solvents; and is completely resistant to arcing or tracking under high voltages and high frequencies.

Plaskon offers you a great range of manufacturing and sales opportunities, either for present or postwar requirements. Our ability to supply Plaskon depends directly upon W.P.B. Allocation Order M-331.

PLASKON DIVISION, LIBBEY · OWENS · FORD GLASS COMPANY
2121 Sylvan Avenue, Toledo 6, Ohio

In Canada: Canadian Industries, Ltd., Plastics Division
Montreal, Quebec

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After preheating, the preform for the head of the pot-feed device is in the soft condition indicated at left. Top and bottom of the molded head are shown at center and right

High density through high frequency

by V. W. SHERMAN*

WHEN our Armed Forces enter enemy territory and, in many cases, when they land on friendly soil, the establishment of a dependable source of potable water is one of the problems requiring immediate attention. While it is true that supplies of drinkable water can be transported to the point of consumption, a wise commander seldom relies upon this method for supplying his troops. Instead he brings with him various types of equipment whereby natural water is made clear and free from harmful amoebic and bacteria life.

One of these potable water purifying plants produces finished water by flocculation, filtration and sterilization—the first of these processes being the most important. The object of flocculation is to make possible by filtration the easy removal from the water of the very fine turbidity or color particles. In this method myriad, tiny jelly-like masses of chemical are formed in the water when a coagulant and an alkali are added in proper proportions. The coagulant used in this equipment is aluminum sulfate, generally known as filter alum. Soda ash is used as the alkali. When mixed in the correct proportions in the water being purified, the strongly alkaline sodium of the soda ash unites with the acid sulfate of the filter alum, thus forming a soluble sodium sulfate. The weakly alkaline aluminum unites with some of the components present in the water to form tiny particles of aluminum hydroxide which are little jelly masses called flock. When first formed, the flock particles are microscopic in size. Through bumping into each other as the result of constant motion, these particles of suspended matter tend to stick together and soon are of a size to be easily visible. At this stage they will strain out when the water is passed through a sand filter. Held suspended in the filter, these particles also serve to entangle suspended matter, the lower forms of animal life such as amoebae which may produce amoebic dysentery, and most of the bacteria in the water.

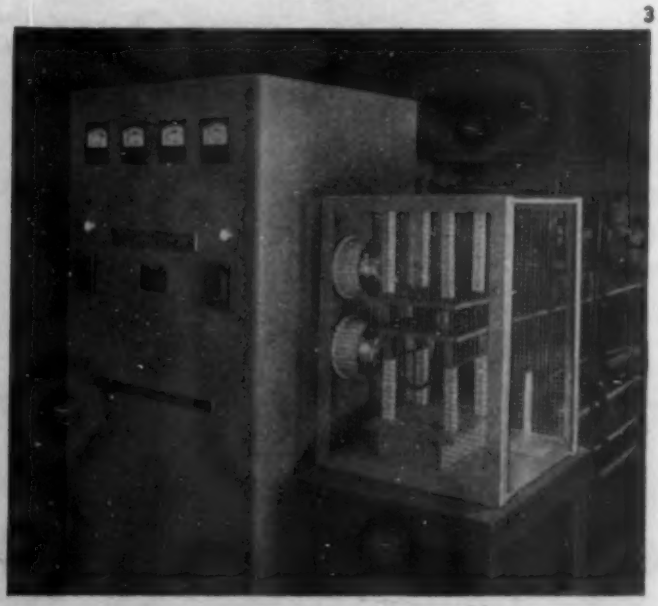
In order to control accurately the flow of the purifying chemicals used in this equipment, a so-called chemical pot-feed device was designed—two units being installed on each purifier. Figure 2 shows the construction and installation of these pot-feeders. The transparent body (bottom, Fig. 4) is made of methyl methacrylate and the head (top, Fig. 4) of

* Industrial Electronics Products Div., Federal Telephone and Radio Corp.

2—*Two chemical pot-feed units are installed on each purifying unit in order to control accurately the flow of the chemicals used to clear the natural water of harmful amoebic and bacteria life.* **3**—*Preheating of the preforms for the head of the pot feeder insures against porous internal sections which result in leakage between parts*

2

3



phenolic. When joined together these two parts form a closed tank which is connected to inlet and outlet openings of a venturi tube by means of saran tubing and fittings. The venturi tube is designed to supply pressure differentials which make possible the bypassing of certain proportions of the water through the chemical feed devices and thence back into the main stream. When the contaminated water is forced through the chemical which is located in the pot-feed body, it dissolves the chemical and the solution which is thus created is carried back to the main stream where the chemicals are mixed and form the flock previously described. The amount of chemical fed into the water can be regulated by needle valves on the head. Markings on the valve handles, which indicate various degrees of water contamination, assist the operator in obtaining the correct proportion.

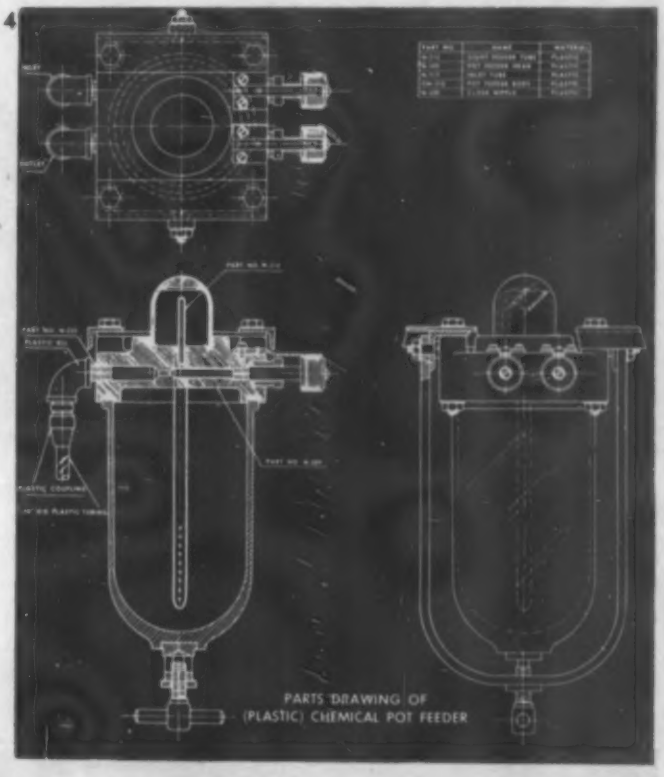
In producing the phenolic head part, which is a fairly large part weighing approximately 1 lb. $6^3/_4$ oz. and measuring roughly 5 × 5 × 2 in., the molder wanted (1) to make sure that there was no leakage between the canals molded in the head; and (2) to be positive that no cracking would take place on the part under extreme temperature changes. A decision was made to investigate high-frequency preheating of the preforms and, as usual, the influence of this heat was successful. Consequently there were no internal strains and the molded part was produced very satisfactorily. While the curing time is reduced in the molding operation, it is necessary to preheat the preforms in the electrodes of this high-frequency oscillator to permit a better piece to be made. Generally speaking, lower hydraulic pressure is applied on molds for molded parts when electronic heating is used. This large hand mold (Fig. 5) came to within approximately $^1/_8$ in. of completely closing before any appreciable slackening in the mold closing speed could be detected. At this point a slight touch of "high" (2000 p.s.i. line pressure) served to complete the closing operation.

Figure 6 graphically illustrates the reason why the mold closes so easily. In this view the operator has removed a heated preform from between the electrodes and with a slight pressure of the fingers has broken it open. In this condition the material is not hard and granular but soft and mushy. The soft condition of the preform is also illustrated in Fig. 1. In this operation the molder has pressed down upon the preform with the heel of his hand, and the cracks in the preform as well as the depression caused by his hand are clearly visible. The two hexagonal bolt heads in the front of the cavity serve to pull out two of the horizontal side pins. A long thin pin, which can be seen in the center of the force plug, molds a vertical hole through the part. After using the oscillator for preheating the preforms, the possibility of these pins being broken was nil. With high-frequency heat used to soften the plastic material, there is no longer a necessity for replacing broken pins.

In presenting this case history on the successful molding of an "impossible" job through the use of high-frequency heat, we have discovered still another advantage that accrues to the molder who uses this method of preheating phenolic preforms. Before turning to high-frequency heating, at no time was the molder able to produce a molded head that did not have porous internal sections which resulted in leakage between parts. The uniform preheating of the material by high frequency produces complete uniformity of the molded part with no indication of any porosity. (*Please turn to page 172*)

4

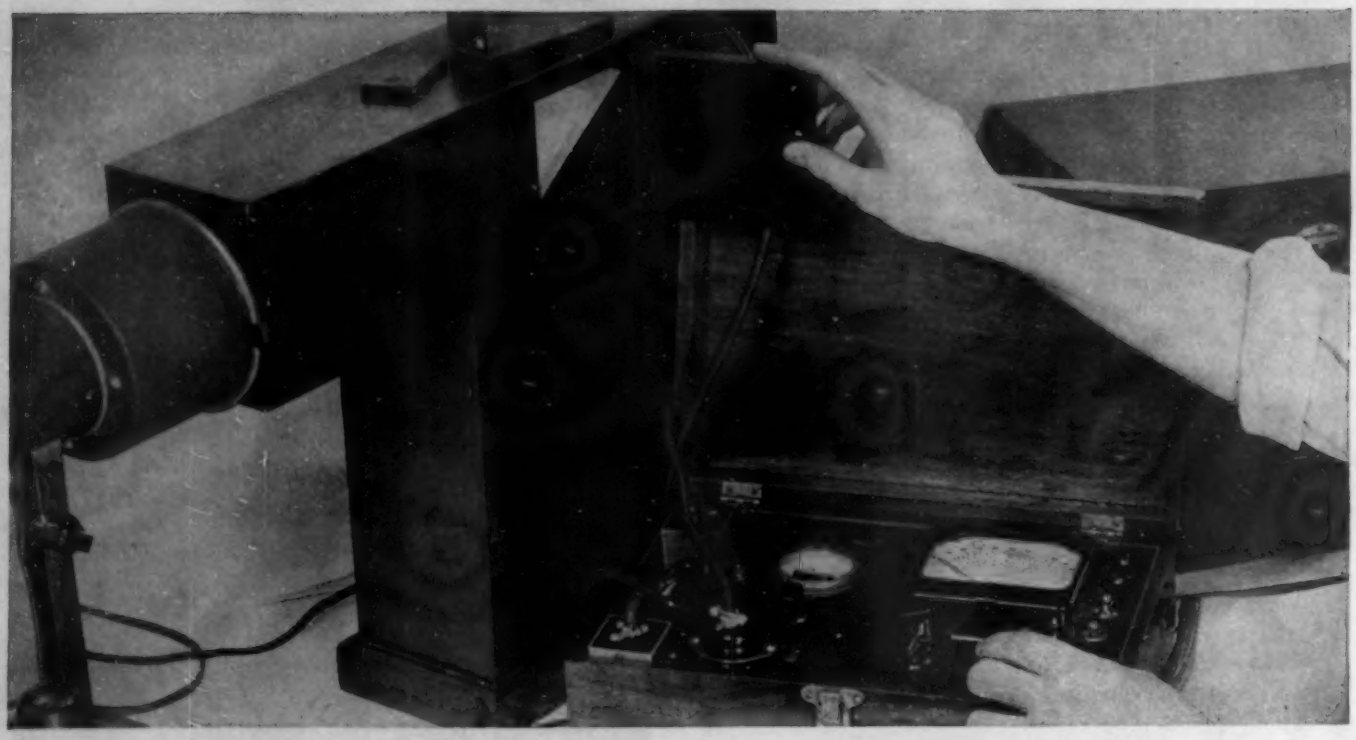
DRAWING, COURTESY % PROPORTIONEERS, INC. %



5

4—In this parts drawing of the pot feeder, the phenolic head is shown at the top. At the bottom are two views of the transparent, methyl methacrylate body of this unit.
5—With the phenolic preform in the mold, an operator places the force plate in position in the cavity preparatory to placement in the press

LIFE ON THE



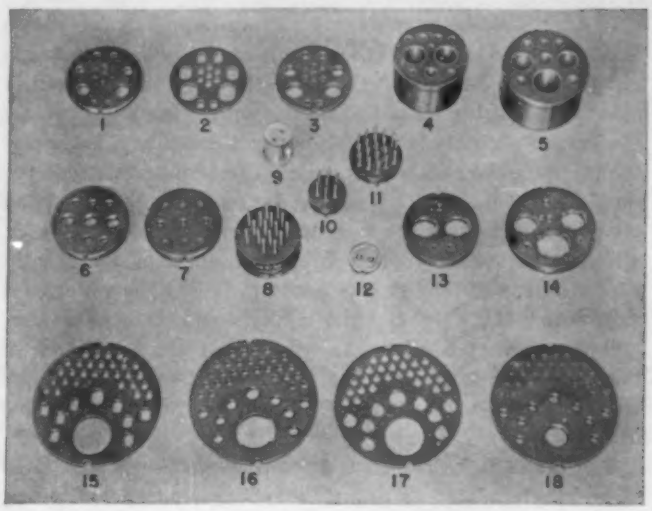
(*Above*) **FLUORESCENCE VALUES** of various dyes to be incorporated into various materials are tested in this photometer at Cyanamid's Calco Chemical Division, leading supplier of dyes and intermediates to the plastics industry. Factors that must be worked out for each specific application to obtain the maximum of fluorescent brilliance and permanence include the quantity of dye, shade-matching since dyes may appear as different colors under visible and ultraviolet light exposures, the resin and filler characteristics of the plastics.

(*Below*) **THE MODERN CHOICE** of major airlines for complete tableware service is MELMAC® No. 1079 (alpha-cellulose filled) because of its light weight, extreme surface hardness and low moisture absorption characteristics.

PHOTO: AMERICAN AIRLINES, INC.

(*Above*) **TEST MOLDING** of a telephone handset in the Central Molding Test Laboratory is an example of the constant development work carried on by Cyanamid to broaden the usefulness and value of plastics in new applications.

PLASTICS NEWSFRONT



(*Above*) **MOLDED PARTS** for Cannon plugs include front and rear socket insulators, socket inserts, and insert assemblies.

(*Above*) **MOLDED INSERTS** with holes for contacts are quickly "drilled" to remove flash. Some cores have contacts molded in place.

MELMAC INSERTS FOR MULTIPLE CONTACT CABLE CONNECTORS

Many parts for Cannon plugs for aircraft electrical circuits made of MELMAC are used by the Cannon Electric Development Company because of its high arc and track resistance, high dielectric strength, and resistance to extremely humid conditions.

(*Below*) **FABRICATED INSERT DISCS** are readily machined from laminated sheets; are easily punched, or drilled to assure accurate alignment when assembled.

(*Below*) **THIS MULTIPLE DIE** molds four inserts, complete with prong contacts, in a single operation.

*Reg. U. S. Pat. Off.

AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
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Cooling water costs in injection molding

by GEORGE W. DeBELL*

IN MANY injection molding plants the cost of water for cooling the machines is a substantial expense item. Some molders assume that this expense is inherent to their operation and make little or no attempt to lessen it. Others believe that the only way they can reduce their water bills is by installing some form of water cooler—frequently one of the evaporative type—and re-circulating water by means of a pump. It is seldom that the water in such recirculated systems can be cooled to as low a temperature as is obtainable in water taken from the city mains. Therefore the re-circulated water usually must be mixed with fresh water in order to obtain the desired low temperatures and replace loss through leakage and evaporation.

Frequently, molders could reduce their water bills materially without increasing their capital investment by the simple expedient of utilizing the cooling water more efficiently. There are two approaches to the problem of reducing the amount of water consumed: 1) to make certain that the various parts of the machines are not being operated at temperatures lower than necessary for satisfactory operation and 2) to consider the possibility of re-using the cooling water from the colder units for cooling the hotter units.

To illustrate the manner in which such savings can be achieved by the simple expedient of making certain that the various units are operating at the highest possible temperatures commensurate with good production, let us consider an injection press piped in the manner illustrated in Fig. 2. The first step is to determine accurately the temperatures at which the machine is being currently operated. The temperatures required for the analysis are:

1. Mold temperature.
2. Temperature of water entering the mold.
3. Temperature of water leaving the mold.
4. Temperature of oil leaving the cooler. This is generally the same as the sump temperature since in most installations the oil goes through the cooler before returning to the sump.
5. Temperature of water entering the oil cooler.
6. Temperature of water leaving the oil cooler.
7. Temperature of the cool end of the injection cylinder.
8. Temperature of water entering the injection-cylinder cooler.
9. Temperature of water leaving the injection-cylinder cooler.

As a check on the temperature rise in the oil it also is advisable to take the temperature of the oil entering the cooler for, while this temperature is not essential for solving the water-cooling problem, it is of interest in determining whether the oil is being heated beyond safe limits in its circuit through the machine.

In addition to determining the above temperatures, it also is necessary to establish the amount of water flowing in each circuit. This can be done by connecting a hose to the outlet side of each of the units and measuring the amount of water discharged per min. from each hose. Generally it is simpler to determine the number of pounds of water per min. than the number of gallons. This can be done readily by selecting a container of appropriate size, determining its empty weight, allowing the water to flow into the container for exactly one minute, weighing the container including the water, and subtracting the weight of the empty container. Of course, greater accuracy can be obtained if the water is allowed to flow into the container for a longer period of time, and the total weight of water is then divided by the total flowing time in minutes.

The above test data on temperature and water flow then should be tabulated as shown in Table I, and the following computations made:

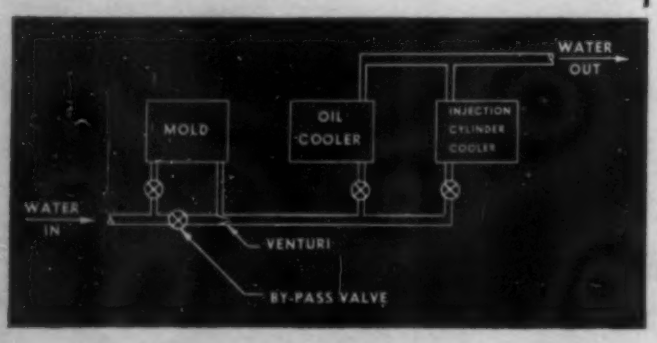
1. Subtract the water-in temperature from the water-out temperature of each unit, and record as the water temperature rise.
2. Multiply the water temperature rise by the water flow in pounds per min., and record as the Btu per minute.
3. Determine the arithmetic average of the water-in and water-out temperatures for each unit, and record as the average water temperature.
4. Subtract the average water temperature from the operating temperature of the unit, and record the difference. This temperature difference will remain constant so long as the same number of Btu per min. are being removed from the unit.

In Table I, representative values have been given for the test data and computations. In addition, in the right-hand column, values are given for the maximum operating temperatures. These maximum allowable operating temperatures will vary somewhat with each installation, but they serve to illustrate the possibility of utilizing higher operating temperatures in many applications.

Now let us consider the effect on water consumption of a 10° F. rise in the operating temperature of each of the units. Referring to Table II the operating temperatures given in the second column from the left are seen to be 10° F. higher in each case than the equivalent values in Table I. If we

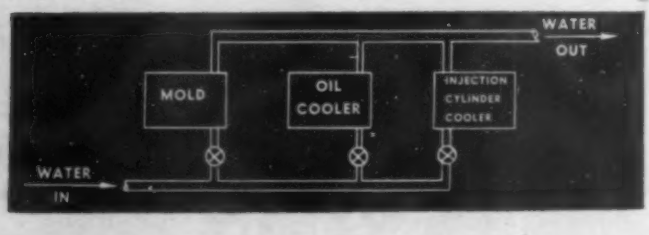
* Consulting Engineer.

1



1—Injection press piping whereby the water is used but once. 2—In this setup, mold cooling water is reused to cool the oil cooler and injection cylinder cooler

2



desire to stabilize the machine at the level which is 10° F. higher, we must remove from each of the units the same number of Btu per min. as in Table I. This requires that the difference between operating temperature and average water temperature remain unchanged. As long as there is no change in the water supply, the water-in temperature also will remain constant. Now we can proceed with the necessary computations.

1. The average water temperature is determined by subtracting the "operating temperature minus average water temperature" from new "operating temperature."
2. The water-out temperature is then computed by doubling the average water temperature and subtracting the water-in temperature.
3. The water temperature rise is, of course, the difference between the water-out and water-in temperature.
4. The water flow in pounds per minute is then determined by dividing the Btu per min. by the water temperature rise. The gallons per min. are equal to the pounds per min. divided by 8.35.

Comparison of the totals per machine given in Table I with those given in Table II shows that by the 10° F. increase in operating temperature we have reduced the water consumption from 10 gal. per min. to 3.07 gal. per min. —a saving of almost 7 gal. per minute. Naturally, savings of this magnitude cannot always be made since it is not always possible to accomplish a 10° F. increase, and since the actual operating temperatures in a specific installation may vary appreciably from the values given in Table I. However, the representative data given in Tables I and II do indicate the value of making such tests and computations.

Thus far we have considered only the potential savings to be made by properly adjusting the operating temperatures in a machine piped as shown in Fig. 2. Now let us consider the additional savings which can be made by using water from the colder units to cool the hotter ones. Referring to the right-hand column of Table I, it will be noticed that while the mold temperature may vary from 80 to 120° F. to take care of different products and different materials, the oil cooler and injection cylinder cooler may be continuously operated at higher temperatures. Therefore, while there are times when the mold temperature must be relatively low, it is not necessary to make provision for such low temperatures in the case of the oil cooler and injection cylinder cooler. We can then re-pipe the mold as shown in Fig. 1 and by this means re-use the mold cooling water to cool the oil cooler and injection cylinder cooler. By the use of the by-pass valve and venturi we are able to regulate independently the three units to attain maximum operating temperatures on each. To illustrate the water savings possible with such a hook-up, let us consider that the mold is operating at 80° F., and that the by-pass valve is closed so that only the water from the mold is used to cool the oil cooler and injection cylinder cooler. In this case, both the oil cooler and the injection cylinder cooler would operate at 137° F. with the oil cooler using approximately 10 lb. per min. of water, and the injection cylinder cooler using approximately 7 lb. per minute. Under these conditions the water flow for the entire machine would be only 2 gal. per min. as compared with approximately 3 gal. per min. for the machine analyzed in Table II and with 10 gal. per min. for the original machine as analyzed in Table I.

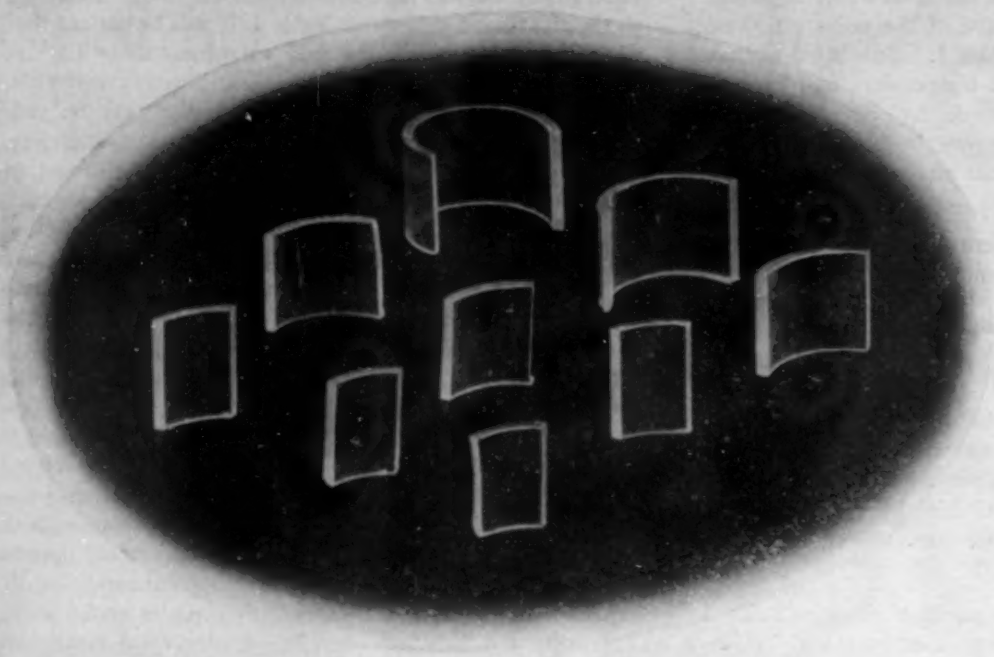
While the foregoing savings in water cost can be made without any modification to the machine except the simple one of installing the by-pass and venturi, still further savings are possible by proper consideration of the detail design of the cooling channels in the mold and of the type of coolers used for the oil and injection cylinders. In making such analyses, it should be borne in mind that such units are actually nothing more than radiators and that the surface area in contact with the cooling (*Please turn to page 178*)

TABLE I.—TEST DATA ON TEMPERATURE AND WATER FLOW

	Test data from machine						*Computations*			
Item	*Operating temperature ° F.*	*Water in temp. ° F.*	*Water out temp. ° F.*	*Water temp. rise ° F.*	*Water flow* gal./min.	gal./min.	*Btu./min.*	*Average water temp. ° F.*	*(Operating temp.) minus (Av. water temp.)*	*Maximum allowable operating temp. ° F.*
Oil cooler	Oil temp. = 110	55	63	8	6	50	400	59	51	130–140
Injection cyl. cooler	Cyl. temp. = 120	55	65	10	2	17	170	60	60	140–150
Mold	Mold temp. = 80	55	65	10	2	17	170	60	20	80–120
Total machine	.....	..	..	..	10	84	740	..	..	.....

TABLE II.—TEST DATA AFTER 10° F. RISE IN OPERATING TEMPERATURE

	Increased 10° F.	*From Table I*			*Computations*				
Item	*Operating temperature ° F.*	*(Operating temp.) minus (Av. water temp.)*	*Btu./min.*	*Water in temp. ° F.*	*Average water temp. ° F.*	*Water out temp. ° F.*	*Water temp. rise ° F.*	*Req'd water flow* lb./min.	gal./min.
Oil cooler	Oil temp. = 120	51	400	55	69	83	28	14.3	1.71
Injection cyl. cooler	Cyl. temp. = 130	60	170	55	70	85	30	5.7	0.68
Mold	Mold temp. = 90	20	170	55	70	85	30	5.7	0.68
Total machine	.....	..	740	..	..	..	..	25.7	3.07



These polystyrene insulators, which come in 3 different sized segments of 90, 180 and 270°, are machined from extruded round tubing and eliminate the use of slower and more expensive molds

Polystyrene insulators

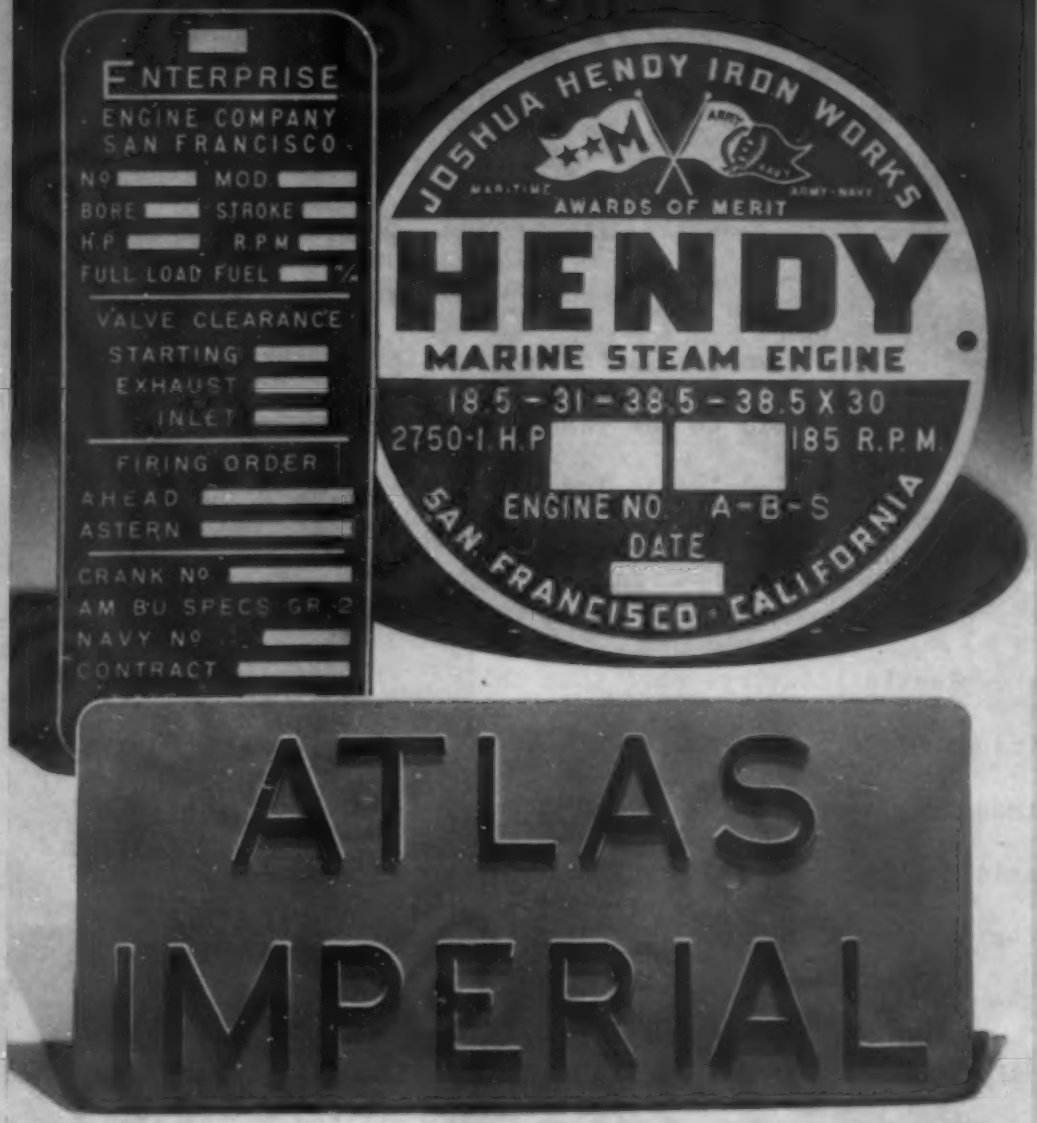
AMONG the most strategic factors affecting our war effort are man- and machine-hours. And at the very top of this strategic list are the man- and machine-hours necessary for the construction of molds. Consequently, whenever this type of work can be eliminated from production, the effect is even more far-reaching than that resulting from a saving of any of our strategic raw materials.

Recently a large manufacturer of electrical parts for the Navy was faced with the necessity of procuring several different sizes of curved sections of polystyrene for use as insulators. Company plans demanded immediate delivery of these parts —such a rush delivery that mold construction was almost out of the question. In the face of this problem the company consulted a midwestern extruder. Not having any injection machines, the extruder proposed to extrude round tubing to the correct inside diameter and wall section, and then fabricate the various sizes and shapes of insulators from this tubing. Since at least three different sizes of these insulators were needed, molding of the part would have called for at least a 3-cavity combination mold or possibly 3 different molds, each mold making a different size. With the construction of molds made unnecessary by the proposed production plan, an immediate saving of $1000 to $1500 was effected. While it is true that price was not the governing factor in this case, the savings made possible by the use of the method were of at least minor consideration.

The extruder was faced with but one problem—a method for cutting the tubing longitudinally into the correct sections. The insulators are furnished in 90-, 180- and 270°-segments, all three having the same $^1/_2$-in. length. Figure 1 shows a view of several of these different parts cut into the $^1/_2$-in. lengths from the $^3/_4$-in. I.D. tubing. This tubing first is cut into extruded lengths of approximately 16 ft., and then divided into 40-in. sections preparatory to fabricating. In the apparatus for machining the tubing into the various segmented sections (Fig. 2) a 40-in. length of tubing with a handle attached to one end, is mounted in a fixture designed so that the ends of the tube are held in position by V-blocks while the entire tube is supported by a V-guide. This guide, not easily seen in the photographs, is placed between the tube and the motor in such a way that it not only supports the tube throughout its entire length but acts as a bearing surface and guide for the saw. The handle of this fabricating unit, located at the right side of the motor, is used to tilt the entire power unit at an angle so that the tubing can be assembled in its proper position between the (*Please turn to page 172*)

PHOTO, COURTESY SANDEE MANUFACTURING CO.

2—A 40-in. length of tubing with a handle at one end is mounted in a fixture which secures the ends in position by V-blocks while supporting the entire tube by a V-guide. This machine feeds the tubing into a saw which slots it in the required lengths



Name plates molded by Remler Co., Ltd., for F. L. Mitchell Company

ame Plates of TENITE an Eastman plastic

NAME PLATES for steam and Diesel engines are injection-molded of Tenite. The plates are fastened to the engines by means of machine screws, and serial numbers and other data are imprinted with metal stamping dies.

With one color inherent in the plastic and another one applied, the name plates contrast sharply with the metal of the engines. Tenite does not corrode, and the lettering of the name plates remains distinct. The lustrous, dirt-resistant surface of Tenite requires no polishing.

Other types of Tenite markers include hotel key tags, lettered instrument panels, advertising signs, theater marquee sign letters, and bulletin board letters. For further information on Tenite and its many uses write to the TENNESSEE EASTMAN CORPORATION (Subsidiary of the Eastman Kodak Co.), KINGSPORT, TENNESSEE.

• • •

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Shear strength of plastic materials

by R. T. SCHWARTZ and EDWARD DUGGER, Jr.*

RELATIVELY little data are available on the shear strength of plastic materials. John Delmonte[1] reported shear strengths of some molded thermosetting and thermoplastic materials determined by a punch and die procedure. Philip Field[2] presented some data on shear strength of several phenolic laminates at −70, +76 and +160° F., showing that the shear strengths decrease with increasing temperature. This is a condition which is characteristic of plastic materials for other strength properties except impact.

This investigation was concerned with the determination of the shear strength at room temperature of a number of thermoplastic and thermosetting plastic materials. The tests were made in accordance with procedures which now are incorporated in Federal Specification L-P-406.[3] Two standard procedures were used, consisting of testing in double shear: 1) rectangular specimens from sheets of $^1/_{16}$, $^1/_8$ and $^1/_2$ in. thickness, employing a Johnson-type shear jig with compressive loading and 2) cylindrical specimens from sheets

* Materials Laboratory, Army Air Forces, Wright Field.

[1] John Delmonte, "Shear Strength of Molded Plastic Materials," ASTM Bulletin No. 114, *25* (Jan. 1942); MODERN PLASTICS *19*, 63–64, 80 (Sept. 1941).

[2] Philip M. Field, "Basic Physical Properties of Laminates," MODERN PLASTICS *20*, 91–102, 126, 128, 130 (Aug. 1943).

[3] Federal Specification L-P-406, "Plastics, Organic; General Specification (Methods of Test)," Government Printing Office, Washington, D. C.

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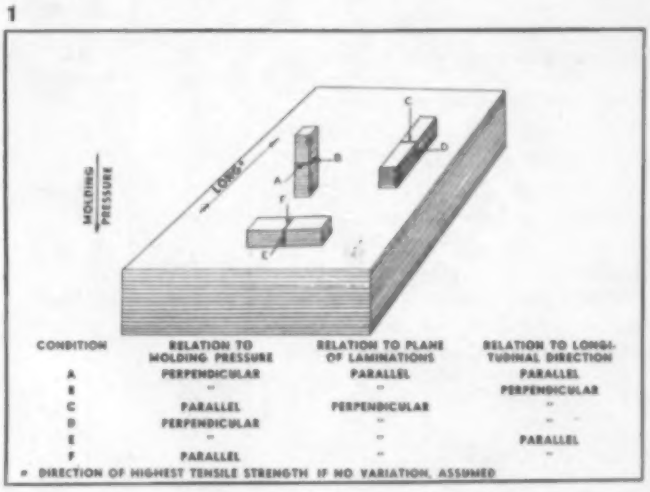

CONDITION	RELATION TO MOLDING PRESSURE	RELATION TO PLANE OF LAMINATIONS	RELATION TO LONGITUDINAL DIRECTION
A	PERPENDICULAR	PARALLEL	PARALLEL
B	"	"	PERPENDICULAR
C	PARALLEL	PERPENDICULAR	"
D	PERPENDICULAR	"	"
E	"	"	PARALLEL
F	PARALLEL	"	"

* DIRECTION OF HIGHEST TENSILE STRENGTH IF NO VARIATION ASSUMED

1—*Relation of shear planes to molding pressure, plane of lamination and longitudinal direction for laminated sheet materials. Arrows show direction of loading of specimens.* 2—*In drawing of a shear jig, tensile load: 1) D is nominal diameter of test cylinder; 2) finish machine after heat treatment; 3) G, grind surfaces; 4) spacer plate—3 to be 0.001 thicker than 1; 5) shear hole edges must be sharp; 6) dimensions in in., tolerances—fractions $^1/_{64}$, specimen diameter—D $^{+0.000}_{-0.001}$, shear hole diameter—D $^{+0.001}_{-0.000}$; 7) shear hole alignment must be maintained; 8) material steel heat treat to Rockwell C35-40*

2

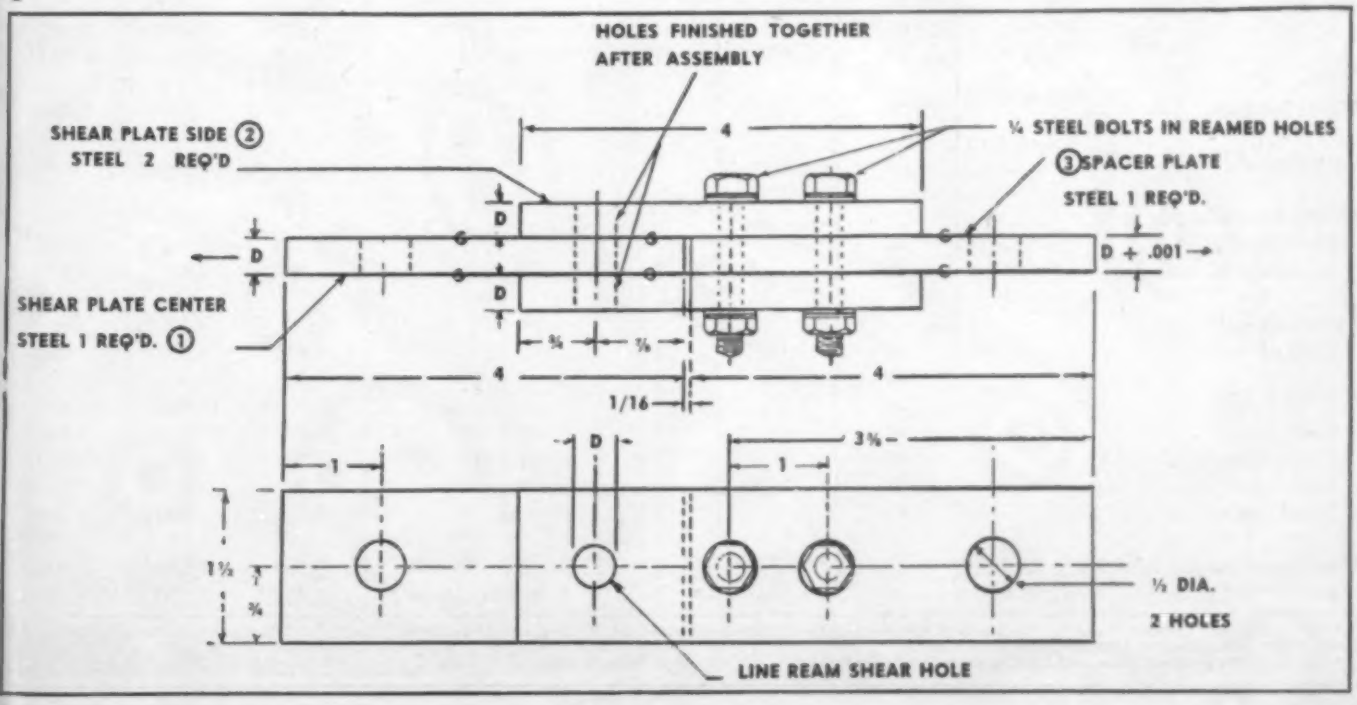

TABLE I.—SHEAR STRENGTH OF PLASTIC MATERIALS AT 77 ± 2° F.

Type of plastic	Test No.	Nominal thickness of sheet, in.	Type of jig[a]	Direction of shear plane with respect to longitudinal direction[b]	Ultimate shear strength, p.s.i.		
					Minimum	Maximum	Average
THERMOSETTING MATERIALS							
Grade L phenolic laminate	1	1/2	J	Parallel (F)	12,500	12,800	12,600
	2	1/2	T	Parallel (F)	11,900	13,300	12,600
	3	1/2	T	Perpendicular (C)	12,600	14,100	13,500
	4	1/16	J	Parallel (F)	10,900	12,100	11,600
	5	1/16	J	Perpendicular (C)	14,200	14,800	14,500
Grade C phenolic laminate	6	1/2	T	Parallel (F)	12,700	13,300	13,000
	7	1/2	T	Perpendicular (C)	14,300	15,300	14,900
	8	1/8	J	Parallel (F)	11,500	12,500	12,100
	9	1/8	J	Perpendicular (C)	13,900	14,700	14,400
	10	1/16	J	Parallel (F)	11,700	12,500	12,100
	11	1/16	J	Perpendicular (C)	11,700	14,300	13,200
Grade XX phenolic laminate	12	1/2	T	Parallel (F)	11,300	12,800	12,300
	13	1/2	T	Perpendicular (C)	12,500	14,900	13,900
	14	1/8	J	Parallel (F)	11,600	11,600	11,600
	15	1/8	J	Perpendicular (C)	12,600	13,100	12,900
	16	1/16	J	Parallel (F)	10,200	11,600	11,000
	17	1/16	J	Perpendicular (C)	12,100	12,900	12,500
High-strength paper phenolic laminate	18	1 5/8	T	Parallel (F)	11,600	12,200	11,900
	19	1 5/8	T	Perpendicular (C)	12,000	12,900	12,200
	20	1 5/8	T	Parallel (E)	14,400	15,700	15,200
	21	1 5/8	T	Perpendicular (D)	15,100	17,100	16,000
	22	1 5/8	T	Parallel (A)	1,700	2,900	2,100
	23	1 5/8	T	Perpendicular (B)	1,700	2,900	2,100
	24	1/2	T	Perpendicular (C)	12,000	13,700	12,700
Phenolic laminate, glass- and cotton-fabric filled	47	3/16	J	Parallel (F)	18,400	18,900	18,600
	48	3/16	J	Perpendicular (C)	18,000	19,100	18,600
Resin-impregnated compressed maple	25	1 1/2	T	Parallel (A)	5,600	7,200	6,000
	26	1 1/2	T	Perpendicular (C)	14,900	16,200	15,500
	27	1 1/2	T	Perpendicular (D)	15,200	17,800	16,500
	28	1 1/2	T	Parallel (E)	7,100	8,100	7,500
	29	1 1/2	T	Parallel (F)	8,400	9,500	8,800
	30	5/8	T	Perpendicular (C)	13,800	16,000	14,900
	31	5/8	T	Perpendicular (D)	14,400	15,700	14,900
	32	5/8	T	Parallel (E)	5,800	6,400	6,000
	33	5/8	T	Parallel (F)	5,700	6,300	6,000
Lignin laminate	34	1/2	T	Parallel (F)	7,000	9,800	8,700
Cast phenolic	35	1/2	T	....	9,100	9,400	9,200
Aniline-formaldehyde resin							
Plasticized	36	1/2	T	....	8,600	9,800	9,300
Unplasticized	37	1/2	T	....	8,900	9,900	9,400
Allyl-type resin							
Unfilled	38	1/2	T	....	4,100	4,900	4,800
Glass fabric	39	1/4	J	Parallel (F)	11,700	13,200	12,600
	40	1/4	J	Perpendicular (C)	9,200	13,600	11,100
Kraft paper	41	1/2	T	Parallel (F)	9,200	10,500	9,600
Hurlbut paper	42	1/2	T	Parallel (F)	8,200	9,000	8,600
Duck base	43	1/2	T	Parallel (F)	7,900	8,700	8,200
Muslin base	44	1/2	T	Parallel (F)	8,200	8,800	8,500
Urea-formaldehyde fabric-base laminate	45	1/10	J	Parallel (F)	6,600	7,200	7,000
	46	1/10	J	Perpendicular (C)	7,500	8,300	7,900

[a] "J" designates Johnson shear jig, thickness of specimen equals thickness of sheet. "T" designates 3-plate jig, using 3/8-in. diameter pins from 1/2 in. thick sheet, and 1/8-in. diameter pins from thicker material.
[b] Letter refers to shear plane and loading direction indicated in Fig. 3; not applicable to isotropic materials.

TABLE I.—SHEAR STRENGTH OF PLASTIC MATERIALS AT 77 ± 2° F. (*Continued*)

Type of Plastic	*Test No.*	*Nominal thickness of sheet, in.*	*Type of jig*[a]	*Direction of shear plane with respect to longitudinal direction*[b]	*Ultimate shear strength, p.s.i.*		
					Minimum	*Maximum*	*Average*
THERMOPLASTIC MATERIALS							
Cellulose acetate, transparent	52	1/2	J	....	2,500	3,100	2,700
	53	1/2	T	....	2,300	2,400	2,400
	54	1/8	J	....	4,700	5,500	5,100
	55	1/16	J	....	5,500	6,100	5,800
Cellulose acetate H3	56	1/2	T	....	5,600	5,800	5,700
Cellulose acetate H5	57	1/2	T	....	5,500	6,800	6,000
Cellulose acetate butyrate H1	58	1/2	T	....	3,600	3,800	3,700
Cellulose acetate butyrate H5	59	1/2	T	....	4,800	5,000	4,900
Polymethyl methacrylate	60	1/2	J	....	5,300	5,500	5,400
	61	1/2	T	....	5,100	5,600	5,400
	62	1/8	J	....	6,900	7,500	7,200
	63	1/16	J	....	7,400	8,600	8,200
Polyvinyl chloride acetate	49	1/8	J	....	6,500	6,700	6,600
	50	1/16	J	....	9,600	10,700	10,000
Polystyrene	51	1/2	T	....	6,000	6,200	6,100

of 1/2 in. or greater thickness, using a 3-plate-type shear jig with tensile loading.

It is interesting to note that shear strength test procedures similar to those used in the present investigation are in use for plastic materials in Germany. W. Kuech[4] employed 10-mm. (0.3937-in.) cylinders tested in double shear in a 3-plate-type tension-loaded jig for thick material. Flat strips taken from thin sheets were tested in double shear.

[4] Wilhelm Kuech, "New Research on the Use of Hardening Plastics for Aircraft Construction," J. Royal Aeronautical Soc., *44*, 44 (Jan. 1940).

3—Johnson shear jig. 4—Diagram of jig. Base of C.I. or mild steel; other parts of steel with hardness at least equal to Rockwell C35. Use 7/16 in. nuts drilled and tapped to fit 1/2 in. studs. Finish surfaces; shear edges shall be sharp. Tolerances: Fractions, ± 1/64 D, ± 0.001

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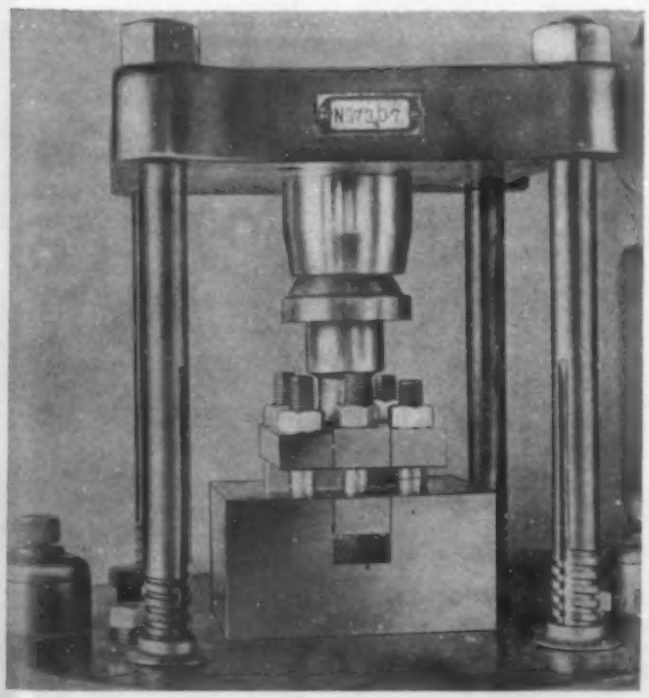

Materials

The materials used in these tests consisted of various thermoplastic and thermosetting plastics in sheet form. The specific gravities and description of the materials are given in Table II, and the thicknesses are given in Table I. The H1, H3 and H5 designations of the cellulose acetate and cellulose acetate butyrate molded materials refer to the relative hardness and flow characteristics of the materials.

Test procedures

Shear test specimens were prepared and tests were conducted in accordance with Paragraph B-4 of Federal Speci-

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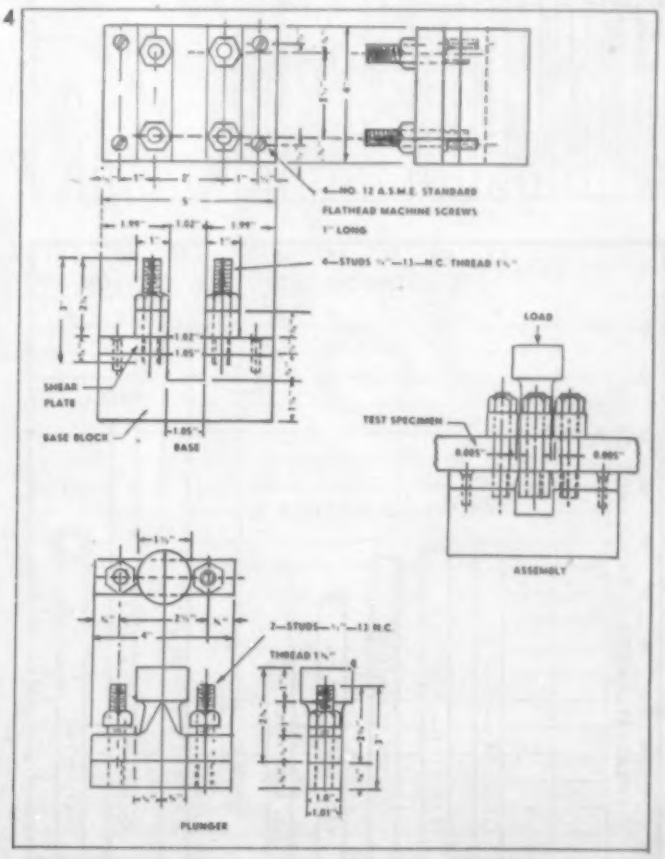
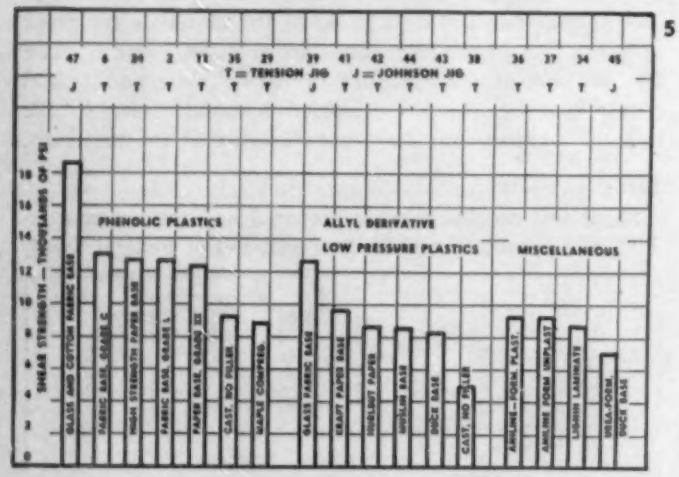


fication L-P-406. Cylindrical shear specimens of 0.375 in. diameter were machined from the sheets of 1/2 in. thickness, and 0.500-in. diameter specimens from the thicker material. Rectangular specimens were 3 in. by 1/2 in. by the thickness of the sheet for 1/8, 1/4, 1/8 and 1/16-in. thick materials. Specimens were taken in both the lengthwise (longitudinal) and crosswise (transverse) direction for those materials having directional properties. The various possible shear planes and directions of loading are illustrated in Fig. 1.

Two types of double-shear jigs were used. One was a tension loading type of 3-plate jig (Fig. 2) used with self-aligning loading devices. The other was a Johnson shear jig (Figs. 3 and 4). A hydraulic testing machine of 20,000 lb. capacity, adjusted to suitable scale range, was used. The rate of head travel under load, 0.020 ± 0.005 in. per min., was controlled manually by a pacing device.

Specimens were conditioned at 77 ± 2° F. and 50 ± 2 percent relative humidity prior to testing for at least 48 hr. for 1/8 and 1/16-in. thick material and 96 hr. for thicker specimens. Specimens were tested at 77 ± 2° F. and at the prevailing laboratory humidity. However, the specimens were tested immediately after removal from the conditioning chamber. Tensile and com- (*Please turn to page 164*)

5—Comparative shear strengths of thermosetting materials. All values for laminates for longitudinal shear plane, load flatwise. 6—Comparative shear strengths of thermoplastic materials. Test numbers for both from Table I



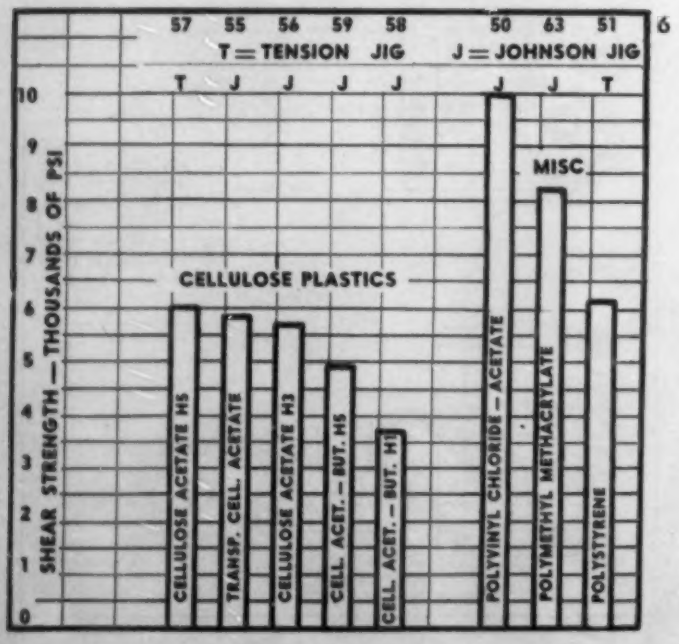


TABLE II.—DESCRIPTION OF PLASTIC MATERIALS

Type of plastic	*Specific gravity*	*Description*
THERMOSETTING		
Phenolic laminate, Grade L	1.34	Fine weave cotton fabric, parallel-laminated sheet; Fed. Spec. HH-P-256
Phenolic laminate, Grade C	1.34	Coarse weave cotton fabric, parallel - laminated sheet; Fed. Spec. HH-P-256
Phenolic laminate, Grade XX	1.34	Paper-base parallel-laminated sheet; Fed. Spec. HH-P-256
Phenolic laminate, high-strength paper	1.40	High strength paper, cross-laminated sheet
Phenolic laminate, glass- and cotton-fabric-filled	1.64	Adjacent layers of cotton fabric and unidirectional glass fabric, cross-laminated
Resin-impregnated compressed maple	1.36	Phenolic - resin - impregnated, parallel laminated compressed maple; AAF Spec. 15065
Lignin laminate	1.39	Paper base, parallel laminated; lignin resin
Cast phenolic	1.36	Cast phenol - formaldehyde resin, transparent amber; no filler
Aniline - formaldehyde resin, plasticized	1.28	Molded aniline-formaldehyde plastic material, translucent amber; no filler
Aniline - formaldehyde resin, unplasticized	1.20	Molded aniline-formaldehyde plastic material, translucent amber; no filler
Allyl-type low-pressure resin with various fillers:		
No filler	1.31	Clear, transparent cast sheet
Glass fabric	1.66	Plain weave glass fabric, cross-laminated
Kraft paper	1.38	Kraft paper, cross-laminated
Hurlbut paper	1.38	Hurlbut rag paper, cross-laminated
Duck	1.35	Unwashed 8-oz. duck, cross-laminated
Muslin	1.36	Washed unbleached muslin, cross-laminated
Urea-formaldehyde laminate, fabric base	1.15	Cotton duck, parallel-laminated
THERMOPLASTIC		
Cellulose acetate	1.28	Transparent sheet; AAF Spec. 12025-B
Cellulose acetate H3	1.31	Opaque molded sheet; Rockwell M hardness 65–68
Cellulose acetate H5	1.31	Opaque molded sheet; Rockwell M hardness 79–82
Cellulose acetate butyrate H1	1.19	Opaque molded sheet; Rockwell M hardness 51–54
Cellulose acetate butyrate H5	1.20	Opaque molded sheet; Rockwell M hardness 67–70
Polymethyl methacrylate	1.18	Cast transparent sheet; U. S. Army Spec. 94-12014-B
Polyvinyl chloride acetate	1.35	Transparent sheet
Polystyrene	1.05	Molded transparent sheet

TABLE III.—COMPARATIVE AVERAGE SHEAR, TENSILE AND COMPRESSIVE STRENGTHS OF PLASTIC MATERIALS AT 77 ± 2° F.

Type of plastic	*Test No.*[a]	*Direction*[b]	*Shear strength, p.s.i.*	*Tensile strength p.s.i.*	*Compressive strength p.s.i.*	*Ratio of shear strength to*	
						Tensile strength	*Compressive strength*
THERMOSETTING MATERIALS							
Grade L phenolic laminate	2	Long.	12,600	17,000	25,800	0.74	0.49
	3	Trans.	13,500	12,300	24,700	1.10	0.55
Grade C phenolic laminate	6	Long.	13,000	14,700	27,800	0.88	0.47
	7	Trans.	14,900	9,900	27,500	1.51	0.54
Grade XX phenolic laminate	12	Long.	12,300	16,100	23,800	0.76	0.52
	13	Trans.	13,900	13,700	23,400	1.01	0.59
High-strength paper phenolic laminate	18	Long.	11,900[c]	25,000	22,400	0.48	0.53
	20	Long.	15,200[d]	25,000	22,400	0.60	0.67
Phenolic laminate, glass- and cotton-fabric-filled	47	Long.	18,600	38,000	27,000	0.49	0.69
	48	Trans.	18,600	37,700	24,000	0.49	0.78
Resin-impregnated compressed maple	29	Long.	8,800	30,000	26,000	0.29	0.34
Lignin laminate	34	Long.	8,700	11,700	17,300	0.73	0.50
Cast phenolic	35	..	9,200	10,000	23,600	0.92	0.39
Aniline-formaldehyde resin							
Plasticized	36	..	9,300	7,900	21,900	1.18	0.43
Unplasticized	37	..	9,400	9,400	22,300	1.00	0.42
Allyl-type resin							
Unfilled	38	Long.	4,800	4,300	15,100	1.12	0.32
Glass fabric	39	Long.	12,600	27,700	9,900	0.45	1.27
Kraft paper	41	Long.	9,600	13,600	11,700	0.71	0.82
Hurlbut paper	42	Long.	8,600	9,900	11,100	0.87	0.78
Duck base	43	Long.	8,200	7,900	12,000	1.04	0.88
Muslin base	44	Long.	8,500	7,700	10,900	1.10	0.78
Urea-formaldehyde fabric-base laminate	45	Long.	7,000	4,800	..	1.46	..
	46	Trans.	7,900	5,000	..	1.58	..
THERMOPLASTIC MATERIALS							
Cellulose acetate, transparent	55	..	5,800	5,900	7,300	0.98	0.80
Cellulose acetate H3	56	..	5,700	6,400	5,900	0.89	0.97
Cellulose acetate H5	57	..	6,000	7,400	8,700	0.81	0.69
Cellulose acetate butyrate H1	58	..	3,700	4,900	4,500	0.76	0.82
Cellulose acetate butyrate H5	59	..	4,900	6,500	6,500	0.76	0.76
Polymethyl methacrylate	63	..	8,200	8,600	12,100	0.95	0.68
Polyvinyl chloride acetate	49	..	10,000	9,600	12,400	1.04	0.81
Polystyrene	51	..	6,100	3,700	15,200	1.65	0.40

[a] Refers to tests in Table I.
[b] Direction of shear plane and direction of loading for tension and compression.
[c] Flatwise.
[d] Edgewise.

Standards for fittings and tubing*

by Wm. M. WHITE†

A REPORT summarizing the objectives and work of the National Aircraft Standards Committee in the standardization of plastic fittings and tubings was published in the August 1943 issue of MODERN PLASTICS.[1] At that time only fifteen of the detail drawings had been approved by the Committee. All details have now been approved for the fittings shown in Fig. 1. The detail drawings of the thirty-seven basic fitting shapes can be obtained from the National Aircraft Standards Committee, care of the Aeronautical Chamber of Commerce of America, Inc., Washington, D. C.

This leaves yet to be approved three specifications: namely, the fitting specification, the tubing specification and the installation specification. The second draft of the fitting specification has been submitted for approval as the basis for an Aeronautical Material Specification. Returns indicate approval as proposed, with only slight adjustments. The tubing and installation specifications will be submitted under similar procedure.

As mentioned in the previous report, phase II of the test program is the testing of parts made precisely in accordance with the established standards. The time at which phase II test will be concluded is unknown since the making of molds primarily for the sake of obtaining fittings for test, has not been encouraged. Parts tested heretofore have been from actual production requirements. Consequently,

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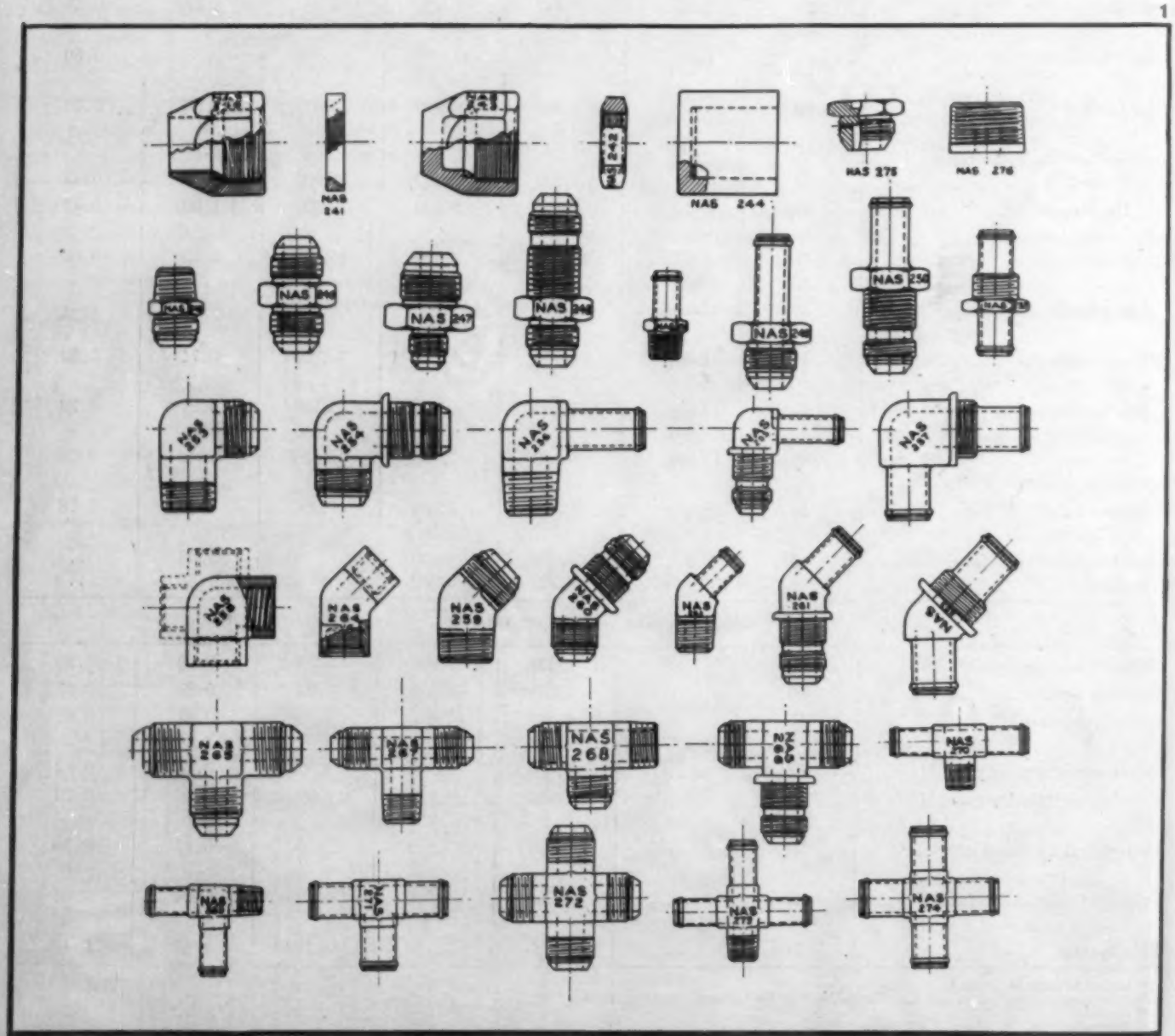

* Presented before a joint meeting of the Rubber and Plastics and Aviation Divisions of the American Society of Mechanical Engineers, New York, N. Y., on Dec. 1, 1943.

† Douglas Aircraft Co., Inc. Chairman, NASC Project Committee P-230-1, Synthetic Fittings and Tubing. Member, SAE Sub-Committee A-3, on Aircraft Valves and Fittings.

[1] "Tubing and Tube Fittings," by Wm. M. White, MODERN PLASTICS *20*, 65–67, 150 (Aug. 1943).

such testing will be made from time to time as the parts become available.

The strength requirements in the fitting specification are established on the basis of the lowest figures of several materials. Such a method establishes a minimum but permits improvement. In other words, the parts must be as good as the specification requirements or better. In the use of these parts, it was determined that installation wrench torques were the proper characteristics to control—the same as with metal fittings. This is because torque more than controls all other characteristics. Originally it was planned to take fittings made to the minimum requirements of the specification and determine figures at which the fittings would fail under torque. The maximum wrench torque permitted in the use of the fittings would then be established at one-half the torque possible, thereby providing a 100 percent margin of safety.

Additional important indications have been obtained from the testing program.

1. Fear of thread stripping has been dissipated as no threads will strip if the parts are up to standard. Parts tested have failed outside of the threads (Fig. 2).

2. The use of a stress ring in the flare nut is now believed to be unnecessary. This is illustrated by the way in which the parts failed (Fig. 3). The failure occurred in tension as a result of applied torque and at a point between the shoulder and the point where the threads of the mating part discontinue. This is natural since the threads of the mating part add strength as far as they go.

3. Some of the smaller size fittings have indicated a lack of the established margin. Unless the margin is reached they probably will be restricted temporarily from aircraft applications.

4. Recent testing of parts made of newly formulated cotton-flock materials has indicated such an increase in strength that it may be possible to apply the wrench torques established for aluminum fittings.

It should be pointed out that in most cases the maximum torque values for aluminum fittings are to protect the flare of the soft aluminum tube rather than to protect the fitting. This is because the flare is the most critical. It is thought that a torque approximately 5 percent greater than that permitted on flare nuts will be sufficient for installing plastic fittings in equipment before attaching the tube. The margin should keep the fitting from turning with the nut.

1—Detail drawings of 37 basic fitting shapes. 2—When tested, these plastic parts failed outside of the threads. 3—The manner in which these parts failed, illustrates a belief that use of a stress ring is unnecessary. 4—Two views of a tee fitting which show the part before and after it has been subjected to the torque test

2

In an effort to use aluminum fitting wrench torques, the plastic fittings must necessarily withstand at least twice as much as the established aluminum fitting values. The test which revealed the possibility of this objective is illustrated in Fig. 4. One view shows the tee fitting unbroken, while the other shows the part after the torque test. A torque of 1680 in./lb. was required for destruction. This strength is illustrated in Fig. 5 and is over four times greater than the maximum wrench torque permitted on an aluminum tube flare which fits the same size part. Thus, we have considerably more than the required margin of strength.

Three of these tee parts were tested. Each required the same torque for failure—an example of surprising uniformity which, of course, cannot be depended upon; hence, the 100 percent margin. Vibration tests of 100 hr. duration were also made with these parts at −65 and 160° F. assembled with aluminum tubing with 90 lb./sq. in. internal air pressure. No failures or leakage occurred. Similar installations of plastic fittings with aluminum tubing are now specified on certain aircraft where the temperature might run too high for plastic tubing. Two of these tee fittings were subjected to maximum bursting pressures at −65 and 180° F., under vibration. One required 1400 p.s.i. at −65° F.; the other required 600 p.s.i. at 180° F.

Advantages of plastic fittings

With the present shortage of manpower, procurement is the primary problem. Metal fitting manufacturers have such backlogs of orders that it requires from 3 to 6 mo. for delivery of some of the most standard and simplest fittings. If molds are available on the equivalent plastic fitting, the order can be filled in 2 to 3 weeks. In the event that the mold must be built, the job usually requires no more than 2 mo. for delivery. Of course, there also are weight and cost savings which are now considered secondary to procurement. However, they are inherent advantages. In peacetime, pro-

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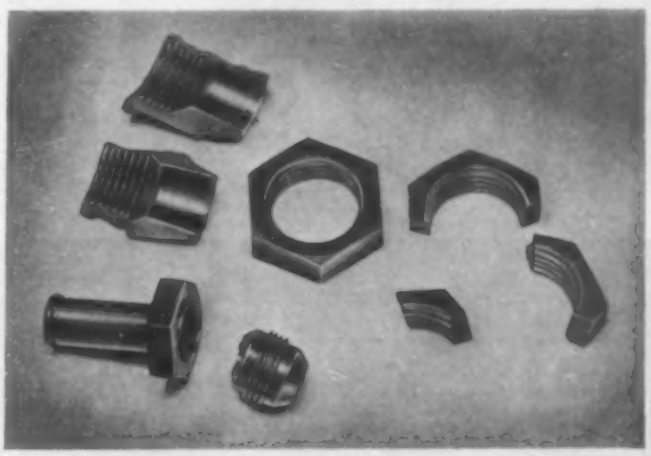

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curement no doubt will take third place, with cost coming second. Weight saving will be the primary advantage since plastic fittings weigh about half as much as aluminum.

The saving of weight is an important item in aircraft. There have been many estimates as to the value of each pound of weight saved. These estimates have been considered to apply to all aircraft due to the failure to mention their basis. However, the pound value actually applies to each model and is based on the average life of that model. For example, a pound saved on a Douglas DC-3, at the present time, is estimated to be worth in excess of $2000. If 20 lb. of plastic fittings are used in newly produced cargo-carrying aircraft, of DC-3 average life, an equal amount of weight is saved. The result is a $40,000 plus value to the operators over the average life of the plane.

A plastic air valve to fit 1-in. tubing (Fig. 6) is an example of the value of weight. This valve was formerly made of aluminum and weighed 1¾ pounds. Made of plastic, it weighs 15/16 lb.—a saving worth approximately $1750. In addition to the weight saving, a saving of approximately 50 percent in cost is realized. And the valve is produced and delivered on short notice.

Another seemingly unimportant item is the extremely smooth surfaces of the internal passages. Such a condition is usually welcomed by the aircraft engineer because any appreciable amount of flow through the proposed system requires extensive calculations to decrease flow friction. The length of the line, the number of bends, the angle of each bend, the number and shape of fittings, and many other factors enter into the establishment of a line size. The lower the friction, the smaller the line size. The result is lighter airplanes.

With present tooling facilities the cost saving to the consumer for the average plastic fitting is estimated to be 75 percent. An even greater saving should be realized with molds having a greater number of cavities and with speedier methods of production. The cost saving will be even more attractive to industries other than aircraft.

Plastic tubing

The present situation on plastic tubing is about the same as it was at the beginning of this program. Today's tubing materials are lacking in resistance to some of the various fluids and the extreme temperatures encountered in aircraft. The greatest temperature range that can be covered with any one tubing is −70 to 190° F. The low temperature for this material is satisfactory at present. However, locations in aircraft where the temperature might exceed 190° F. must be avoided. Temperatures of 190° F. are reported to have been measured on the sun-exposed portions of aircraft sitting on the ground in desert regions. On the other hand, few people realize that 10 mi. above these hottest zones, temperatures around −100° F. prevail.

Because of the postwar trend toward stratosphere flying, it will be necessary to establish the low limit at −100° F. The temperature range for the tubing would then be −100 to 250° F. In order to make the greatest use of the material the tubing must have good impact strength at the low temperature limit and stand reasonable internal pressure at the high limit. Pressure requirements for such tubing have not as yet been established nor are they likely to be until the tubing is available. However, they are expected to be approximately 250 pounds per square inch. The present maximum pressure permitted (*Please turn to page 162*)

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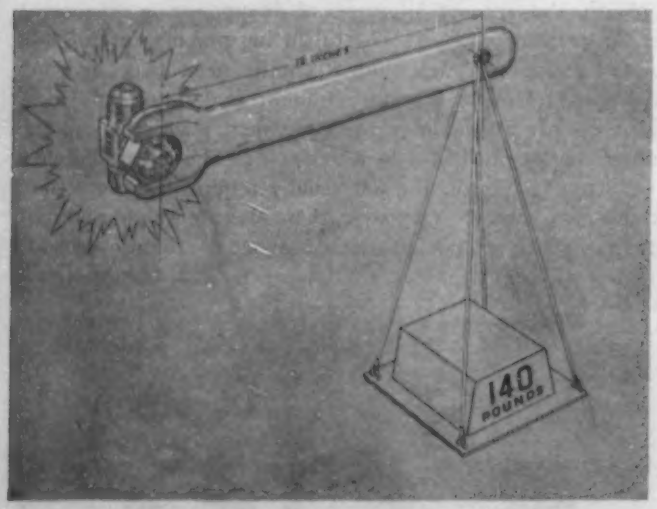

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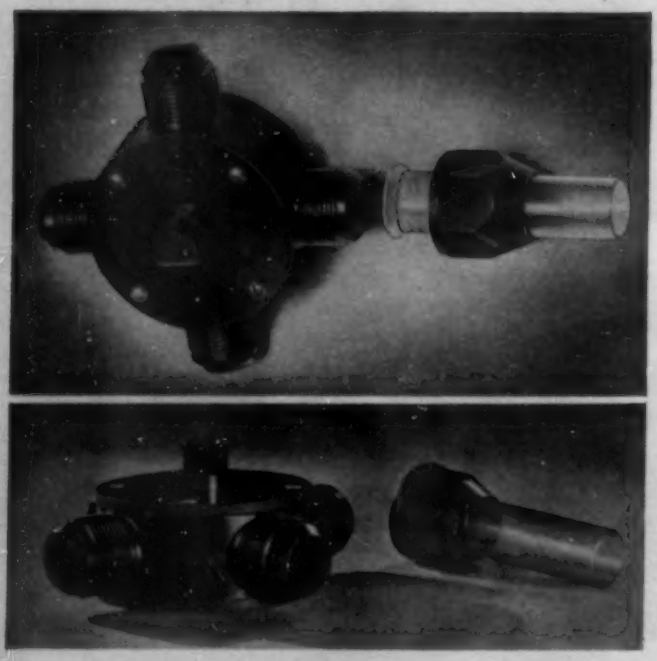

5—This sketch illustrates torque strength required for the destruction of a tee fitting. 6—Two views of plastic air valve made to fit a 1-in. tubing. 7—Chart showing extent to which tubing has been pressure-tested

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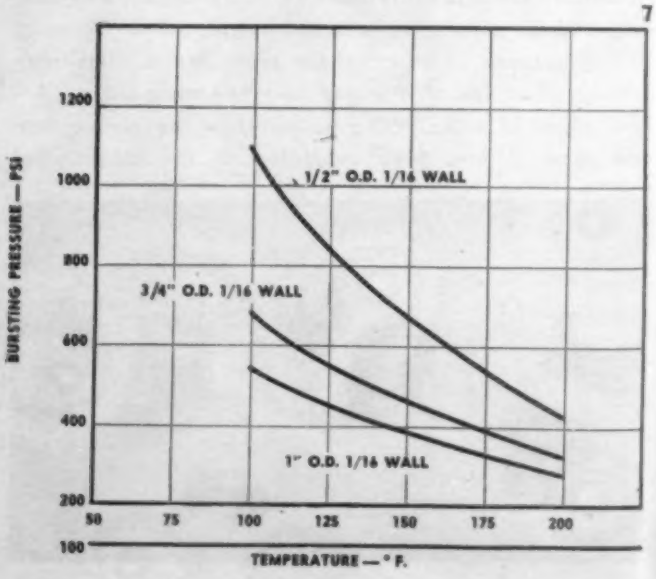

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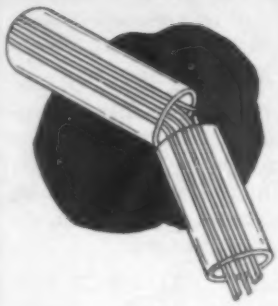

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TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

CHARACTERISTICS OF PLASTICS AS ENGINEERING MATERIALS. W. F. Bartoe and D. S. Frederick. S.A.E. J. *52*, 54–61 (Feb. 1944). Low density, ease of fabrication, low thermal conductivity, transparency and low unit cost for mass-production items are characteristics of organic plastic material that make them attractive to the designer and the engineer. The most important general considerations, for which data are not given in ordinary tables, in the applications of any plastic material are 1) the effect of the nature and mode of application of stress, 2) the amount of permanent dimensional change with time, 3) the required service temperature range, 4) the previous history of the material and 5) the effect of temperature on the physical properties. Data on methyl methacrylate plastic are used to illustrate the general considerations necessary for successful design. Investigation of the effect of conditioning on plastic deformation showed that the lower the water content of the plastic the less the plastic flow. The dimensional change of plastic parts due to the relaxation of forming strains must be considered. Parts made by stretching, blowing, injection molding and extrusion contain more forming strains than parts made by casting, machining and positive pressure molding. The latter are consequently more stable. Elevated temperatures and relative humidities increase the rate at which relaxation and dimensional changes take place.

ADDITIONAL DESIGN FEATURES OF MOSQUITO BOMBER. Product Eng. *14*, 767–9 (Dec. 1943). Some additional design features of the mosquito bomber are described. Information is given on tailplane and fin attachment, weatherproofing, repair, structural weights and types of wood used. Balsa wood has been found to be the only satisfactory material for supporting the plywood skins. The outer surfaces are weatherproofed by covering with airplane fabric and airplane dope. The end grains are coated with a phenolic type sealer.

Chemistry

POLYMER DISTRIBUTION OF VARNISH RESINS. H. E. Adams and P. O. Powers. Ind. Eng. Chem. Anal. Ed. *15*, 711–14 (Dec. 1943). An approximate estimate of the distribution of polymers in varnish resins may be made by precipitating the resin from dilute solution with measured amounts of a nonsolvent, while determining the decrease in light transmission through the medium. This titration is reasonably rapid and can be carried out in 20 minutes. This method has been used with hydrocarbon resins, rosin-modified phenolic and maleic resins and pure phenolic resins using toluene as the solvent and methanol or hexane as the nonsolvent. The titration curves obtained in this manner may be used to compare resins of the same type. To estimate polymer distribution from these curves, the concentration of nonsolvent at which carefully separated fractions of a resin are precipitated must be determined.

CHEMICAL LINKING OF RUBBER AND OF OTHER OLEFINS WITH PHENOL-FORMALDEHYDE RESINS. J. I. Cunneen, E. H. Farmer and H. P. Koch. J. Chem. Soc. *1943*, 472–6 (Oct. 1943). Rubber, isoprenic olefins and doubtless most olefinic substances combine because of their unsaturation with the condensation products of phenol and formaldehyde to give chroman derivatives. The detailed structure of the combination products, the relation of chroman-formation to the formation of phenol-formaldehyde resins and the significance of certain ancillary features of the reaction are also discussed.

Properties

EVALUATING LOW-TEMPERATURE STIFFNESS AND BRITTLE POINT IN ELASTOMERS. F. L. Graves and A. R. Davis. India Rubber World *109*, 41–4 (Oct. 1943). Test specimens are bent through an arc of 90° at a reproducible rate of deformation. Brittle points determined in this way represent the highest temperature at which fracturing of the elastomer may be expected. The brittle point is determined to the nearest 1° C by testing at a succession of temperatures. The low-temperature stiffness value recommended is the percent increase in load required to produce 25 percent elongation on going from 25 to −25° C. The various methods which have been proposed for determining these properties are also discussed.

THE APPARENT SECOND-ORDER TRANSITION POINT OF POLYSTYRENE. T. Alfrey, G. Goldfinger and H. Mark. J. Applied Physics *14*, 700–5 (Dec. 1943). At high temperatures (above 80° C.) the specific volume of polystyrene is an explicit function of the temperature, $dV/dT = 0.00043$. At low temperatures (below 40° C.) the specific volume of polystyrene depends upon its past thermal history, $dV/dT = 0.00024$, although V is not explicitly fixed by the temperature alone. When a sample of polystyrene is cooled at constant rate it contracts according to the higher expansion coefficient until some critical region of temperature, and then contracts according to the smaller coefficient. The position of the critical temperature region depends upon the rate of cooling. The faster the cooling, the higher the "transition point." In the intermediate temperature range (40 to 80° C.), complex time effects can be observed. A sample heated from 20° C. to this intermediate range will first expand according to the small expansion coefficient and then contract slowly toward a smaller volume. The rate of this contraction is greater at higher temperatures.

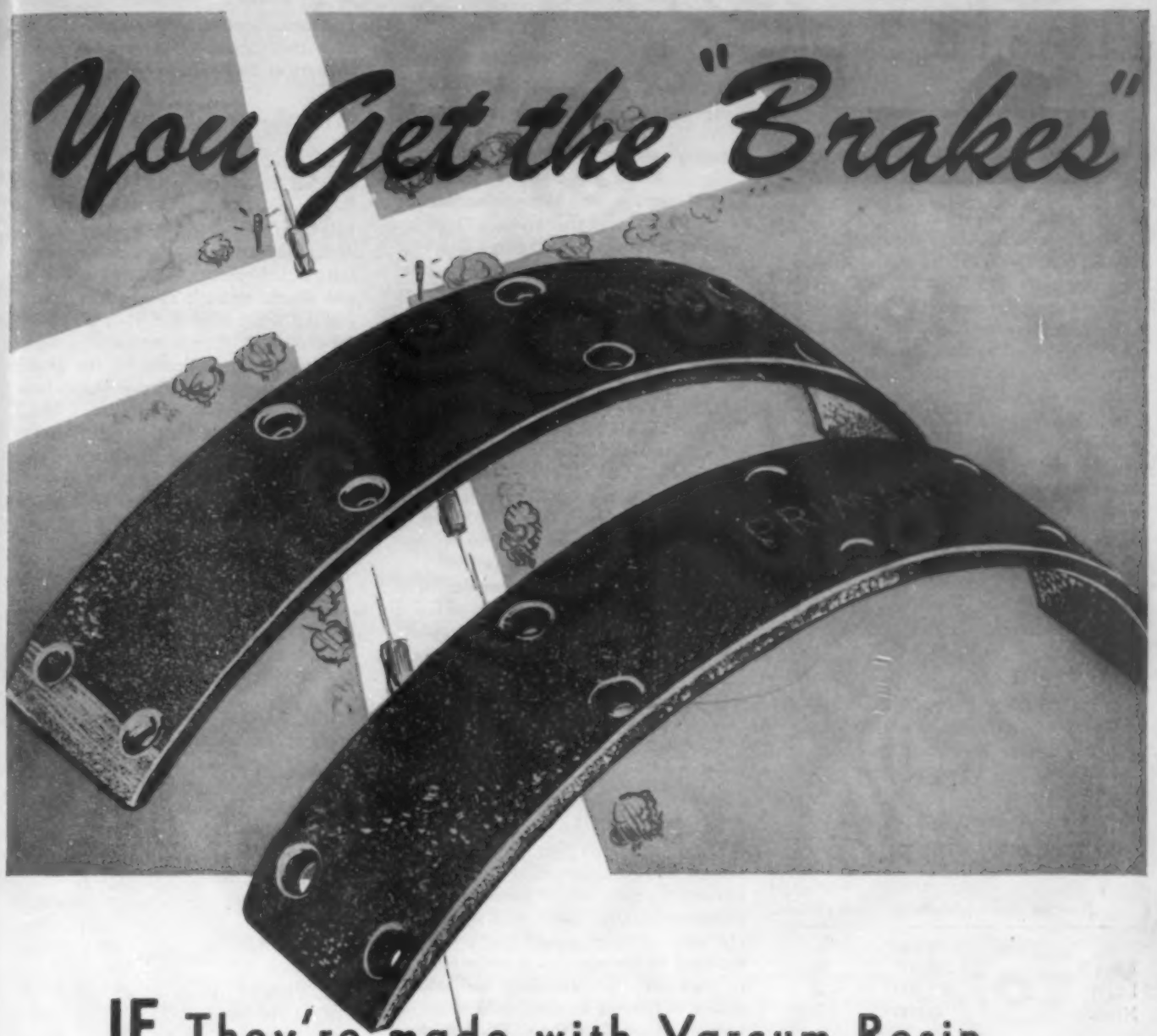
Testing

NON-DESTRUCTIVE TESTING BY X-RAYS. R. H. Cooke. Plastics *7*, 438–445 (Oct. 1943). A schematic layout illustrating an x-ray department for visual and radiographic inspection of moldings is shown and the principle of the method discussed. In addition to providing a means of determining the location and condition of inserts without destroying the part, this method has possible applications in the examination of moldings for microscopic flaws and foreign inclusions, the study of homogeneity and the determination of curing times.

TESTING PLASTIC GAS MASK LENSES. M. H. Bigelow. Illum. Eng. *38*, 523–525 (Nov. 1943). The shadowgraph method for testing surface defects on plastic gas mask lenses is described. Referee sample lenses with known defects are used for comparison.

NEW TENSILE TEST PIECE FOR PLASTICS. B. Frischmuth. Plastics *7*, 359–364 (Aug. 1943). Data obtained in comprehensive tests on a proposed tensile test piece with various materials molded in the same mold by 5 different firms are presented in tables and graphs.

APPARATUS FOR MEASURING THE GAS PERMEABILITY OF FILM MATERIALS OF LOW PERMEABILITY. A. C. Shuman. Ind. Eng. Chem., Anal. Ed. *16*, 58–60 (Jan. 15, 1944). Apparatus is described for measuring the gas permeability of film materials having permeabilities as low as 0.001 cm.³/100 in.²/24 hr. at standard temperature and pressure. The low range for previously reported methods (water-vapor permeability and balloon-fabric permeability) is about 100 cm.³/100 in.²/24 hr. The apparatus combines simplicity of design, simplicity of manipulation and high sensitivity in a unit which can be fabricated in most machine shops. The measurements are made under conditions of one atmosphere pressure differential.



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PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

FIRST SOYBEAN FIBER PLANT STARTS OPERATIONS. Chem. and Eng. News *21*, 2110 (Dec. 25, 1943). The first commercial production of a new fiber made from soybeans was started on Dec. 2 by the Drackett Co., Cincinnati, Ohio. Less than 5 yr. ago this fiber was a $400 per lb. laboratory curiosity. The new soybean fiber is said to be as warm as wool, resilient, strong and durable, and can be made either moisture-absorbent or moisture-resistant. It may be blended with cotton or wool, or may be woven or spun into fabric. It has already been made experimentally into blankets, felt hats, underwear, hosiery, suitings and upholstery fabrics. Currently, this company produces about 70,000 tons of soybean meal and 15,000 tons of soybean oil annually.

REVIEW OF SYNTHETIC RUBBER PROGRAM. India Rubber World *109*, 258 (Dec. 1943). Progress in the construction of plants for the manufacture of synthetic rubber and its raw materials is reported to be as follows:

Product	*Rated capacity scheduled*	*Plant capacity completed*
	long tons	%
Buna S	736,000	80
Butyl	75,000	28
Neoprene	40,000	100
	short tons	
Butadiene		
From alcohol	230,000	87
From petroleum	460,000	39
Styrene	202,700	81

SYNTHETIC FIBERS FOR THE POST-WAR WORLD. D. G. Woolf and W. W. Chase. Textile World *93*, 105–20 (Sept. 1943). A discussion of the factors which will affect the application of synthetic fibers in the postwar world. In the battle of the synthetics there are now 3 fronts: 1) synthetic vs. natural; 2) synthetics vs. synthetics; and 3) new methods of fabrication brought in by the synthetics vs. the older methods. Data on the manufacture, mechanical properties, chemical resistance, solubility, affinity for dyes, resistance to moth and mildew, types and sizes, uses, manufacturers and trade names of viscose rayon, cuprammonium rayon, acetate rayon, nylon, polyvinyl chloride acetate, polyvinylidene chloride, protein and glass fibers are given in chart form. A list of synthetic fibers, which are in the experimental stages or on which production has been suspended, is also given. These include modified cellulose, ethyl cellulose, cellulose acetate butyrate, soybean, peanut protein, corn meal, alginate and synthetic rubber fibers.

Materials

CORN PROTEIN PLASTIC FILLS UNIQUE WAR NEED. W. L. Morgan. Ohio State Univ., Eng. Expt. Sta. News *15*, No. 4, 19–20 (1943). Corn protein, zein, dissolved in alcohol forms a lacquer which produces hard, tough, transparent, nearly colorless, continuous films on drying. The lacquer has a low viscosity so that thick films are easily made. The films have good resistance to abrasion and are resistant to water, to greases and to oils. The zein films are more resistant to water than shellac films. This coating material has found many applications, particularly as a substitute for shellac and for coating wrapping papers for packaging items for overseas shipment.

WOOD-CLOTH AND WOOD-PAPER LAMINATES. John Delmonte. Trans. A.S.M.E. *66*, 55–59 (Jan. 1944). Experimental data are presented to show the advantages obtained by combinations of resin-impregnated paper and cloth with plywood. Higher tensile properties are achieved by the addition of paper laminae to plywood. Stretchability and adaptability to forming to small radii of curvature are attained by the addition of cloth laminae. Dimensional stability of plywood faced with phenolic-resin-treated cloth or paper is far superior to that of unprotected plywood.

Molding and fabricating

HAND GRENADE NO. 69. British Plastics *15*, 385–390 (Dec. 1943). The 69 plastic hand grenade is a missile approximately 4 in. long consisting of a water- and weather-resistant container fitted with a priming charge and a high explosive bursting charge. Production of the huge output required has been spread over several firms. The design of molds and production methods used by these various firms are compared.

TRANSFER MOLDING. M. Freund. British Plastics *15*, 318–321 (Nov. 1943). Some engineering problems involved in transfer molding are discussed. An outstanding feature of the process is the change in the heat transmission which proceeds under forced convection as well as conduction, and results in time saving. The forces applied are high and may disrupt the fibrous fillers and affect the strength of the finished product.

Applications

INFLATABLE LIFE - SAVING RAFTS IN THE WAR EFFORT. J. G. Kreyer. Mechanical Engineering *66*, 121–129 (Feb. 1944). The development, design and construction of pneumatic life rafts are discussed. The types of fabrics and plastic and rubber coatings used in making these rafts and their accessories are described. The latest trend in the use of these rafts is indicated by the production of a large-sized boat accommodating 25 men and 1000 lb. of provisions. In its canvas packing case this raft measures only 7 × 5 × 1.5 ft., taking comparatively little space on a deck. Widespread use of such life saving craft on ships and aircraft can be expected in the postwar period.

PLASTICS IN THE BUILDING TRADE. T. Warnett Kennedy. British Plastics *15*, 261–265 (Oct. 1943). The author concludes that it is no longer a matter of opinion whether or not plastics will invade building. On their intrinsic merits they will inevitably do so. Future applications of plastics in fittings and building parts are tabulated under the following headings: structural, walling, floors, stairs, founds, insulation, finishes, doors, windows, plumbing and bathroom equipment, lighting and electrical supply, heating, ventilation, trimming, decoration, kitchen equipment and miscellaneous.

Coatings

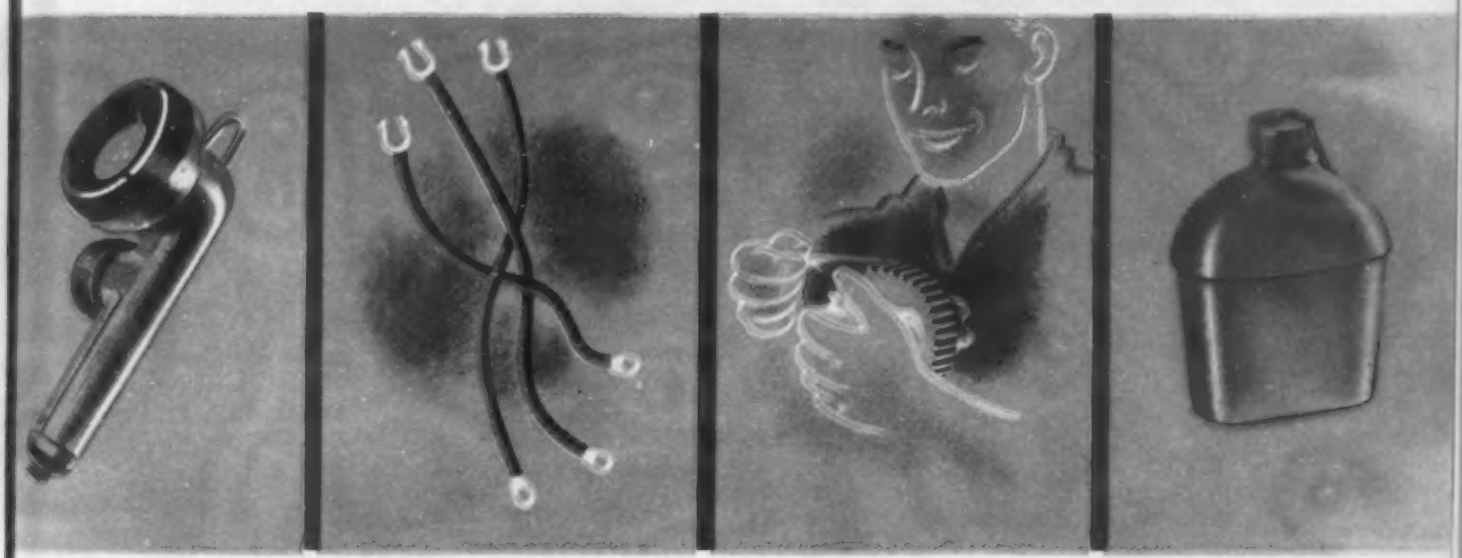
STYRENE AS A SURFACE-COATING RAW MATERIAL. D. H. Hewitt. Paint Tech. *8*, 83–84 (1943). Styrene polymers are suitable as coating materials. Satisfactory materials are made 1) by combining them with oil soluble material, 2) by reacting them with oils or oil derivatives, 3) by the introduction of groups which increase the solubility and 4) by preparing resins of a suitable degree of polymerization.

CELLULOSE NITRATE LACQUER CONTAINING CHLORINATED RUBBER. A. Kraus. Nitrocellulose *14*, 44 (1943). A large number of plasticizers were added to mixtures of chlorinated rubber and cellulose nitrate in an attempt to make these 2 plastics compatible. None of the plasticizers produced compatibility.

NEW METHOD FOR TESTING AIRPLANE FABRIC. Aero Digest *44*, 118 (Jan. 1, 1944). An instrument for testing doped airplane fabric on the plane is described. No failures occur when the fabric and dope are in good condition. Rotten fabric, even when covered with fresh dope, and brittle dopes fail.

All different—all tough jobs but Ethocel is the plastic specified

Ethocel is basically tough—this outstanding quality, plus wide adaptability, extends its usefulness to many different applications.



Here are four products that tell a story of diversified service. Each presents its special set of problems—yet each is best produced with Ethocel. Look them over, they may tell you how this versatile plastic can help meet your own requirements.

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WATER PAINT. A. M. Howald, M. H. Bigelow and J. A. Murray (to Libbey-Owens-Ford Glass Co.). U. S. 2,334,096–7, Nov. 9. Pigment is dispersed in a neutral solution of urea-formaldehyde resin, the solution is evaporated and finally mixed with water and an acid catalyst.

POLYMERS. H. Hopf and S. Goebel (to General Aniline and Film Corp.). U. S. 2,334,195, Nov. 16. Ethylene and an unsaturated compound, capable of reaction with ethylene, are copolymerized at 55 to 180° C. at pressures from 100 to 300 atmospheres in the presence of an inert organic solvent and an oxygen supplying catalyst.

PRINTING PLATES. O. F. Wood. U. S. 2,334,233, Nov. 16. Printing plates are formed by passing a plastic through kneading rollers in a boiling bath of a nonsolvent liquid having a boiling point at the softening temperature of the material and applying to a molding form.

COATING. H. W. Arnold, G. L. Dorough and G. H. Latham (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,334,236, Nov. 16. Cellulosic material is coated with a copolymer of unsymmetrical dichloroethylene and a copolymerizable compound containing a methylene group attached by a double bond to a carbon which is attached to a negative group.

PLYWOOD ADHESIVE. E. C. Knowles and F. C. McCoy (to Texas Co.). U. S. 2,334,270, Nov 16. A composition comprising casein and a resinous distillate of petroleum.

MOLD. R. B. Reeves U. S. 2,334,509, Nov. 16. An apparatus for molding hollow articles from or lining hollow articles with plastic materials.

ABRASIVE. H. V. Allison (to Allison Co.). U. S. 2,334,526, Nov. 16. An article containing abrasive material bonded with a synthetic elastomer copolymer including butadiene and acrylic nitrile, an organic solvent for the copolymer and a thermoplastic resin which will react with the solvent to form a thermosetting resin.

UREA RESIN. G. F. D'Alelio (to General Electric Co.). U. S. 2,334,545, Nov. 16. A condensation product of a mixture of urea, an aliphatic aldehyde and an aldehyde-reactable mono salt of a polyamine.

SCOTCH TAPE. G. Schieman (to International Plastic Corp.). U. S. 2,334,585, Nov. 16. A film of rubber hydrohalide laminated to a film of cellulose acetate, a pressure sensitive adhesive coating on one side and a repellent film on the other side.

SCREEN. C. Dreyfus. U. S. 2,334,754, November 23. Insect screen comprising an open texture fabric containing threads of twisted and adhesively set strips of foil of an organic ester of cellulose.

RESIN. H. C. Cheetham (to Resinous Products and Chemical Co.). U. S. 2,334,904, November 23. A thermosetting resin which is cured by mixing with a powdered cation exchange material in its hydrogen form and a water-soluble salt of a water-soluble acid having a dissociation constant above 10^{-4}.

INORGANIC FIBROUS MATERIAL. W. M. Bergin and A. L. Simison (to Owens-Corning Fiberglas Corp.). U. S. 2,335,102, November 23. A lightweight resilient bat of glass fibers is prepared by depositing simultaneously glass fibers and an aqueous emulsion of petroleum oil, an emulsifying agent and a thermosetting aldehyde condensation product in water-soluble form, evaporating the water, and heating to convert the resin to the water-insoluble state.

RUBBERLIKE MATERIAL. E. Konrad and R. Ludwig (to Alien Property Custodian). U. S. 2,335,124, November 23. Aqueous emulsions of products of the conjoint polymerization of butadiene-1, 3 and styrene in aqueous emulsion.

ADHESIVE. L. L. Salfisberg (to Ivers-Lee Co.). U. S. 2,335,159, November 23. A thermoplastic resin is used to seal a packaging container.

LAMINATED PRODUCT. H. D. Minich. U. S. 2,335,190–1, November 23. An elongated film of rubber hydrochloride is heated and stretched, overlapping adjacent portions into a thread-like product while heated, and cooling while in the stretched position, and employing the same technique by wrapping the film around a central core, and thereby forming a coating for an elongated object.

REINFORCEMENT. M. C. Meyer (to Duranol Products, Inc.). U. S. 2,335,293, November 30. A container composed of plastic material comprising a side wall and an end wall adjacent, the walls being held together by means of a strand of metal coated with plastic.

COATING. M. E. Wysong (to Wysong Plastic Coating Corp.). U. S. 2,335,333, November 30. A flat sheet of fibrous material is coated with a film of polymerized vinyl acetate solution, the film is dried, printing is applied and a film of cellulose acetate is cast upon the surface.

MOLDING METHOD. S. L. Willis. U. S. 2,335,371, November 30. A molded object is produced by applying a coating of plastic solution to a mold and adding granular material capable of absorbing solvent from the solution.

PROPELLER. R. W. De Vore and B. H. Young. U. S. 2,335,394, November 30. A propeller molded from thermosetting resin.

UREA-FORMALDEHYDE RESIN. F. Nozicka (to Alien Property Custodian). U. S. 2,335,440, November 30. A storage-proof product of urea and formaldehyde containing as hardening agent a carboxylic acid salt of a reaction product of hexamethylenetetramine and an aldehyde.

POLYVINYL LACTAMS. C. Schuster, R. Sauerbier and H. Fikentscher (to Alien Property Custodian). U. S. 2,335,454, November 30. A N-vinyl lactam is heated with a polymerization catalyst such as an organic or inorganic peroxide.

CASEIN FIBERS. K. Börner (to Alien Property Custodian). U. S. 2,335,576, November 30. The wet formaldehyde-hardened, mineral-acid-reacting fibers of casein are floated in an aqueous liquid containing ammonia.

LAMINATED BODIES. F. M. Weir (to Marine-Air Research Corp.). U. S. 2,335,624, November 30. A composite laminated sheet is prepared by joining two or more sheets with a

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How Good is a Plastic Mould? Even if it is the very last word in accurate technical detail, which is the way moulds are made at Tech-Art, it won't be worth one penny of the money you spend for it if you fail to properly engineer your product first. Good moulds, can even then, avail you little, if you fail to choose the right plastic for your particular product.

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layer of a thermoplastic substance, curving the sheet, applying heat and finally pressure.

VINYL RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,335,651, November 30. The product of polymerization of a vinyl ester of a halo-phenoxy substituted aliphatic monocarboxylic acid and a vinyl, acrylic, or an allyl compound.

COATING. F. B. Root (to Ellis-Foster Co.). U. S. 2,335,701, November 30. A coating material consisting of a condensation product of furfuryl alcohol, urea and formaldehyde, a drying accelerator, a stabilizer and a plasticizer.

COATED FABRIC. M. H. Chamberlin (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,335,739, November 30. A fabric coated with a mixed cellulose ester of several lower aliphatic acids and an overcoating of cellulose nitrate.

RESIN. G. F. D'Alelio and J. W. Underwood (to General Electric Co.). U. S. 2,335,846, December 7. The reaction product of an aldehyde and a triazine derivative.

TERPENE RESIN. S. G. Burroughs (to Pa. Industrial Chemical Corp.). U. S. 2,335,912, December 7. A turpentine liquid consisting of beta-pinene is polymerized by the use of a polyvalent metal halide capable of being hydrolyzed to give an acid reaction.

PROTECTIVE LAYER FOR FILM. A. Jung and G. Wilmanns (to General Aniline and Film Corp.). U. S. 2,335,944, December 7. A photographic film is protected by a layer comprising an ester of cellulose with a polybasic acid.

SEALING COMPOSITION. A. L. Parker. U. S. 2,335,958, December 7. A sealing and anti-seize composition for pipe threads comprising a solution of a vinyl resin and a thermoset resin.

RESIN. M. A. Pollack and A. G. Chenicek (to Pittsburgh Plate Glass Co.). U. S. 2,335,962, December 7. An insoluble infusible resin is prepared from the polymerized esters of a saturated aliphatic alcohol and an acrylic acid by heating in the presence of an unsaturated alcohol.

CONTAINER. C. W. Vogt. U. S. 2,335,978, December 7. A method for increasing the capacity and tensile strength of containers composed of plastic sheet material by stretching and inflating under heat and tension and cooling while stretched.

PHONOGRAPH RECORD. V. Yngve (to Carbide and Carbon Chemicals Corp.). U. S. 2,335,986, December 7. A phonograph record comprising a vinyl resin base, a filler containing charcoal and an abrasive.

COATED FABRIC. R. L. Lester (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,336,265, December 7. A window shade material comprising fabric having a film superimposed thereon consisting of cellulose nitrate, a plasticizer and pigment.

LAMINATED STRUCTURE. C. J. Malm (to Eastman Kodak Co.). U. S. 2,336,273, December 7. Cellulose acetate and cellulose acetate-butyrate are laminated by successive layers of cellulose acetate-butyrate having varying acyl contents.

CELLULOSE TRIACETATE. J. Spence and S. S. Sweet (to Eastman Kodak Co.). U. S. 2,336,310, December 7. A film-forming solution comprising a non-acetone-soluble cellulose triacetate in a solvent mixed with acetone, the resulting film having improved flexibility characteristics.

DICYANDIAMIDE-FORMALDEHYDE COMPLEXES. K. E. Ripper (to American Cyanamid Co.). U. S. 2,336,370, December 7. The simultaneous condensation of dicyandiamide, melamine and guanidine carbonate with formaldehyde under alkaline conditions.

LINEAR POLYAMIDES. W. O. Baker and N. R. Pape (to Bell Telephone Laboratories, Inc.). U. S. 2,336,384, December 7. A polyamide body is surface hardened by exposing to a fluid agent such as an organic solvent containing a swelling agent, so that the surface is partially penetrated, evaporating the solvent, and finally heating below the melting temperature until the surface hardens due to crystallization.

PIGMENTED LACQUER. G. Klinkenstein, C. Frey and E. F. Tuttle, Jr. (to Maas and Waldstein Co.). U. S. 2,336,484, December 14. A printing lacquer for cloth consisting of an aqueous emulsion of urea-formaldehyde resin, xylol, butyl alcohol, alkyd resin, phenol-modified alkyd resin, pine oil, Bentonite, methyl cellulose and pigment.

LAMINATED GLASS. F. R. Conklin and J. D. Ryan (to Libbey-Owens-Ford Glass Co.). U. S. 2,336,531-2, December 14. Glass plates are laminated with an adhesive comprised of cellulose acetate butyrate plasticized with an alkyl phthalate or dibutyl sebacate.

GLAZING UNIT. J. J. Hopfield (to Libbey-Owens-Ford Glass Co.). U. S. 2,336,544, December 14. A glazing unit is prepared by metallizing one surface of a sheet of glass, bonding to another sheet with a layer of plastic to form a sheet of laminated safety glass.

MOLD. J. H. S. Skoning. U. S. 2,336,578, December 14. A mold for plastic bodies comprising two conformed mold bodies of metal, each having a separate floater-type liner of rolled alloy steel stock.

INSULATED ARTICLE. N. R. Peterson (to Dow Chemical Co.). U. S. 2,336,636, December 14. A porous insulating material is treated with an aqueous solution of a polyvalent metal salt of a carboxy alkyl cellulose and a volatile alkali, shaped in a mold and dried.

SYNTHETIC RESINS. W. J. Sparks and D. C. Field (to Standard Oil Development Co.). U. S. 2,336,648, December 14. Viscous liquid or solid resinous products are prepared by subjecting a mixture of an iso-olefin and an olefin halide to the action of a Friedel-Crafts catalyst.

THERMOSETTING RESIN. W. R. Collings, R. D. Freeman and R. M. Upright (to Dow Chemical Co.). U. S. 2,336,672, December 14. Lignocellulosic material is pulped in alkali solution in the presence of an alkaline or alkaline earth phenolate to form a suspension of cellulosic fibers in a solution of a phenolate lignin complex, cooling, adding an aldehyde, heating to cause reaction and finally precipitating the mixture with acid.

COATING. C. M. Langkammerer, W. S. Gocher and A. J. Jennings (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,336,792, December 14. A rubber article is coated with a mixture of a vinyl resin and a phenol-aldehyde resin.

INTERPOLYAMIDES. R. H. Wiley (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,336,824, December 14. An interpolyamide comprising the reaction product obtained by heating the reaction product of hexamethylenediamine with sebacic acid and of tetramethylenediamine and adipic acid.

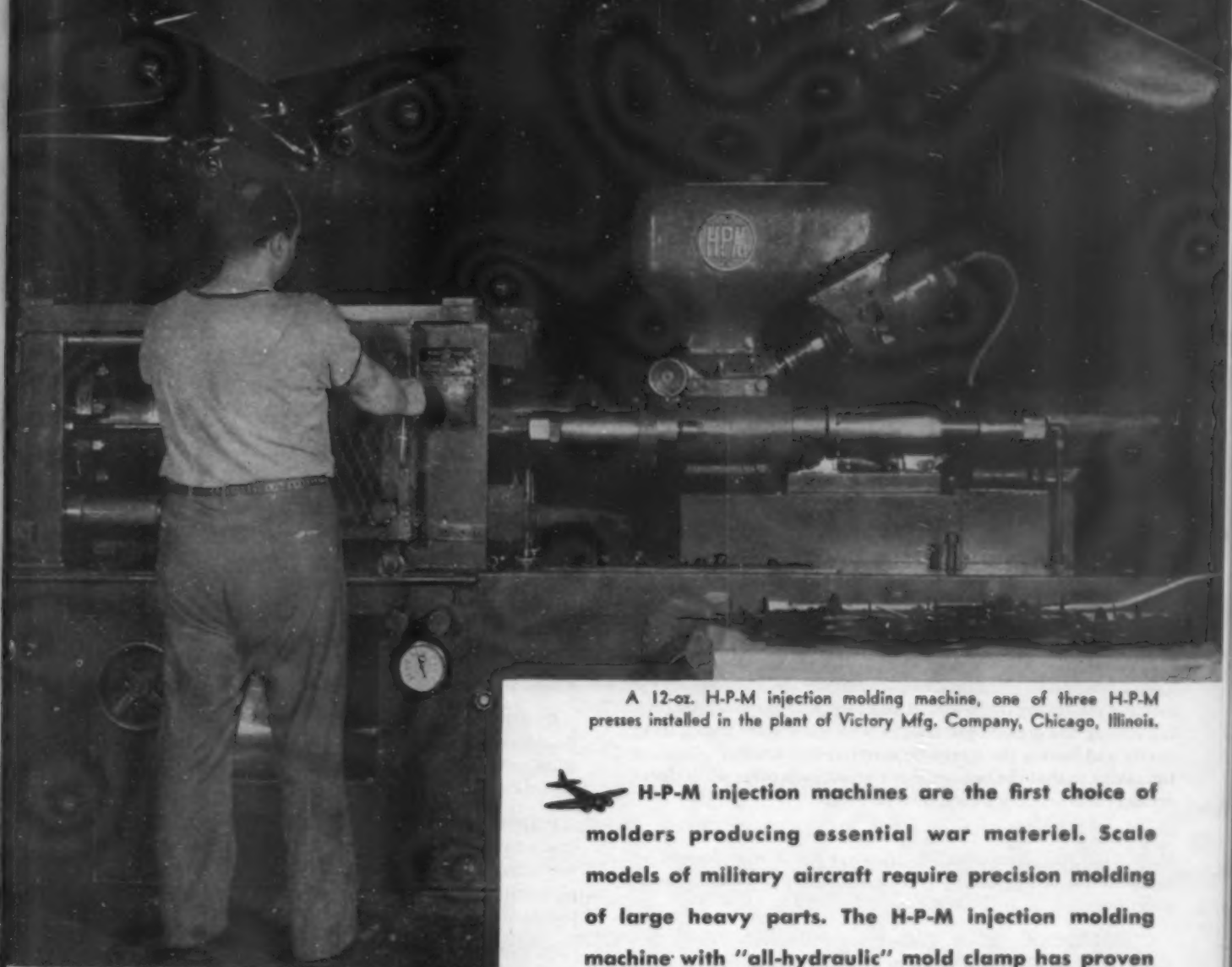
CELLULOSE COPOLYMER. E. Freund. U. S. 2,336,985, December 14. The copolymerization product of cellulose acetocrotonate and vinyl acetate.

VENEER. E. L. Vidal and L. J. Marhoefer (to Vidal Corp.). U. S. 2,337,007, December 14. A structure for aircraft composed of several hollow units, each comprising a plurality of sheets of wood bonded together with resin adhesive and molded to shape.

MOLD. R. W. Erdle (to Dental Research Corp.) U. S. 2,337,036, December 21. A mold, having a central cavity and a pouring opening, composed of plasticized polymerized vinyl halide.

(*Please turn to next page*)

Scale Models of Military Aircraft are H·P·M INJECTION MOLDED ★ ★



A 12-oz. H-P-M injection molding machine, one of three H-P-M presses installed in the plant of Victory Mfg. Company, Chicago, Illinois.

This C-54 Douglas transport model was injection molded by Victory Mfg. Company for Cruver Mfg. Company. Machine used — 12-oz. H-P-M. Body weighs 8 ozs., wing 12 ozs.

H-P-M injection machines are the first choice of molders producing essential war materiel. Scale models of military aircraft require precision molding of large heavy parts. The H-P-M injection molding machine with "all-hydraulic" mold clamp has proven to be the ideal production unit for this type of work.

If you are considering plastics, or plan to increase your present molding plant facilities, be sure to investigate H-P-M plastics molding presses.

THE HYDRAULIC PRESS MFG. COMPANY
Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit, and Chicago. Representatives in Principal Cities.

HPM **PLASTICS MOLDING PRESSES** · Injection · Compression Electronic

RESINS. E. B. Kester (to Koppers Co.). U. S. 2,337,051, December 21. Resins are produced by heating together fatty oil and naphthalene-formaldehyde condensation product.

SAFETY GLASS. J. D. Ryan (to Libbey-Owens-Ford Glass Co.). U. S. 2,337,275, December 21. Laminated glass is produced by applying to one surface of each of 2 sheets of glass a coating consisting of a heated plastic containing an excess of plasticizer, reducing temperature, causing exudation of the plasticizer, pressing the sheets together so as to remove the excess plasticizer, and uniting with heat and pressure.

RESINS. G. F. D'Alelio (to General Electric Co.), U. S. 2,337,313, December 21. An acid-curing thermosetting resin is prepared by reacting a bis-(halogeno aliphatic amido) derivative of divalent hydrocarbon with an aldehyde.

CELLULOSE ESTER. L. W. A. Meyer and F. R. Conklin (to Eastman Kodak Co.). U. S. 2,337,340, December 21. A composition comprising a slightly hydrolyzed cellulose ester of butyric acid and di-2-ethylhexyl adipate.

COATING COMPOSITION. F. R. Stoner, Jr., and G. W. Seagren (to Stoner-Mudge, Inc.). U. S. 2,337,424, December 21. A corrosion-inhibitive coating composition comprising a chlorine-containing thermoplastic resin and a stabilizing and corrosion inhibiting substance such as the methyl, ethyl, propyl, or butyl monoester of phosphoric acid.

COMPOSITION. J. S. Tinsley (to Hercules Powder Co.). U. S. 2,337,508, December 21. A cellulose ether is color stabilized with isophorone.

PLASTIC. J. H. Lum (to Monsanto Chemical Co.). U. S. 2,337,523, December 21. A thermosetting composition comprising a heat reactive phenol-formaldehyde resin and massaranduba wood flour as filler.

RESIN. G. F. D'Alelio and J. W. Underwood (to General Electric Co.). U. S. 2,337,547, December 28. A resin is prepared by reacting an aldehyde with a diazine derivative.

MOLDING. M. A. Crosby (to Hydraulic Development Corp., Inc.). U. S. 2,337,550, December 28. A means for molding plastic organic material and inorganic material comprising forcing the organic material in a softened state into a mold cavity and forcing the inorganic material into another section of the cavity so that the two sections contact each other while under pressure and produce a composite structure.

VINYL RESIN. C. Borgin (to Commercial Solvents Corp.). U. S. 2,337,635, December 28. A vinyl acetal resin formed by condensation of formaldehyde with a partially hydrolyzed polyvinyl ester.

COPOLYMER. M. A. Pollack (to Pittsburgh Plate Glass Co.). U. S. 2,337,681, December 28. A copolymer of styrene and a saponifiable derivative of an alpha haloacrylic acid.

CONTACT LENS. G. Weinberg. U. S. 2,337,701, December 28. The apparatus for forming a contact opthalmic lens from transparent plastic material.

REFLECTOR. H. B. Wood (to Lumelite Corp.). U. S. 2,337,703, December 28. A light-reflecting element comprising a blank formed of an acrylate resin and having a depression in the rear surface containing projections is mounted on a sheet material having reflecting properties.

POLYMER. F. T. Peters (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,337,834, December 28. A synthetic linear polyamide plasticized with a monocarboxylic acid polyhydric alcohol ester in which at least one hydroxyl group of the alcohol is unesterified.

RESINS. G. F. D'Alelio (to General Electric Co.), U. S. 2,337,873-4, December 28. An oil soluble dehydrated resinous reaction product of an acidic unsaturated alkyd resin and a liquid alkaline catalyzed partial condensation product of formaldehyde and a substituted phenol.

PHENOLIC RESIN. H. I. Hersh (to General Electric Co.). U. S. 2,337,890, December 28. A thermosetting resin is prepared by reacting, in the presence of monoamylamine, a mixture of hydrocarbon-substituted phenols, formaldehyde and an oil component consisting of castor and oiticica oils.

PLASTIC SHEETS. R. P. Scherer. U. S. 2,337,935, December 28. A machine for forming capsules of plastic materials.

CAKE KNIFE. N. K. MORRIS (to J. E. Krilow). U. S. 2,338,007, December 28. A knife molded from thermoplastic resin.

VINYL RESIN. J. R. Lewis, L. B. Morgan and W. M. Morgan (to Imperial Chemical Industries Ltd.). U. S. 2,338,187, January 4. A heat-stable composition containing a high-molecular weight polymerized vinyl chloride resin and an alkali metal, lead or zinc salt of dihydroxyquinoline.

EXTRUSION MACHINE. H. Reedman. U. S. 2,338,203, January 4. An extrusion machine for moldable material adapted to set solid, comprising a chamber for receiving the material and a hopper, the lower rear portion of which is connected to a reciprocating impeller.

TUBES. H. H. Snyder. U. S. 2,338,210, January 4. Heat deformable plastic tubing is treated by inserting the end into a mold, heating the forward end of the tube in the mold until the end of the tube is closed, removing from the mold and, while still plastic, drawing to a thread, and finally severing the thread.

COUMARONE-INDENE RESINS. S. Caplan (to Harvel Research Corp.). U. S. 2,338,229, January 4. Diethyl sulfate is dissolved in gas-house oil drip containing indene and coumarone, and the solution is heated at 120 to 140° C. to produce polymerization.

STYRENE RESIN. S. Caplan and W. F. Schaufelberger (to Harvel Corp.). U. S. 2,338,230-1, January 4. Styrene alone or with an aldehyde is heated with a polymer of cashew nut shell liquid, marking nut shell liquid or Japanese lac to form a resin.

RESIN. L. A. Gruenwald. U. S. 2,338,429, January 4. Urea-formaldehyde resin is cured by the addition of an ammonium salt of ethyl phosphoric acid ester and the application of heat.

PHENOLIC RESINS. B. Habraschke (to Alien Property Custodian). U. S. 2,338,430, January 4. Phenol-formaldehyde condensates are rendered non-yellowing by treating the free phenol in such condensates with a fatty acid having 9 to 18 carbon atoms.

SUPER POLYAMIDES. H. Kroeper, F. Kohler and K. Wolf (to Alien Property Custodian). U. S. 2,338,443, January 4. Viscosity stable polyamides are produced by condensing equimolecular amounts of diamine and dicarboxylic acid with the glutaric acid salt of hexamethylene diamine.

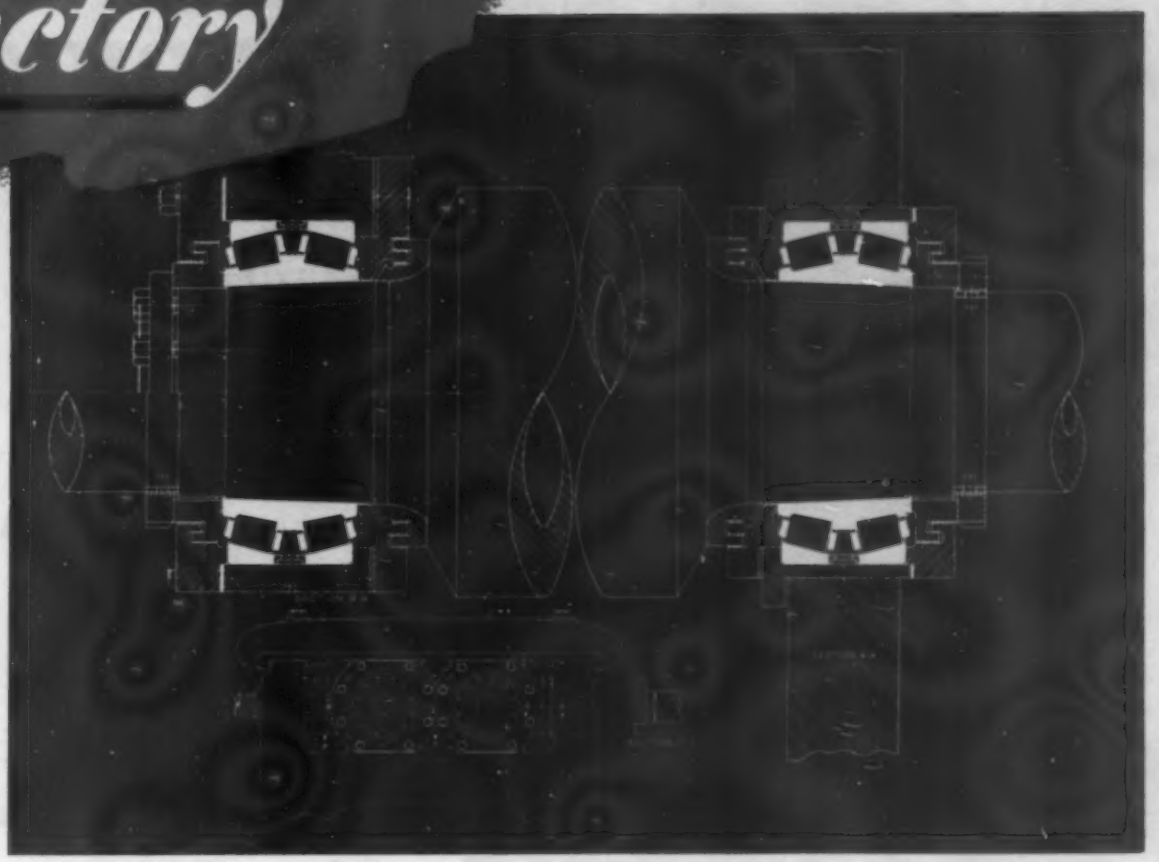
LACQUER. G. Schultze (to Alien Property Custodian). U. S. 2,338,461, January 4. A baking lacquer consisting of chlorinated rubber, a hard resin such as phenol-formaldehyde, urea-formaldehyde, etc., an oil-modified alkyd resin and a rubber vulcanization accelerator.

UREA-FORMALDEHYDE RESIN. L. Smidth. U. S. 2,338,464, January 4. A non-staining moldable resin is prepared by reacting neutralized aqueous formaldehyde solution with urea, adding a cellulose filler and removing water.

POLYAMIDE. K. Thinius (to Alien Property Custodian). U. S. 2,338,469, January 4. A polymeric condensation product of hexamethylenediamine, adipic acid and caprolactam, containing 3-chloropropyleneglycol-2, phenyl ether-1 as plasticizer.

KEEP YOUR PLASTICS MILLS ROLLING FOR *Victory*

Typical application of Timken Bearings on plastics mill roll necks.



By mounting Timken Bearings on the roll necks of plastics mills several important advantages can be secured. They are: faster, smoother operation; reduced power consumption; simplified lubrication; greater precision; lower maintenance; increased endurance; freedom from lubricant leakage and resultant contamination of the product.

If the builders and users of steel rolling mills had been content to stick to obsolete plain bearings, steel production would be far from what it is today — in quantity and quality. In fact the modern four-high continuous strip mill would not have been possible without roller bearings. So why continue to use plain bearings in plastics mills? The Timken Roller Bearing Company, Canton, Ohio.

What after Victory? Don't wait to find out—it may be too late. Prepare now with re-designed equipment containing a full complement of Timken Bearings.

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AIRTRONICS

High-Frequency Heat Generator

★ Simplified Automatic Timing Controls

★ Wide Flexibility of Heat Output

★ Greater Safety for Operators

★ Compact . . . Economical

CUT TIME CYCLES BY AIRTRONICS HEATING OF PREFORMS

The principle of electronic heating has been thoroughly proven as a means of speeding molded plastics parts production. Now the art is further advanced by the new AIRTRONICS high-frequency heat generator which combines many important new features.

Designed after long study of the molders' problems, these units contain many features that simplify operation, eliminate the danger of under or overheating, and function with a minimum of attention.

The AIRTRONICS heat generator has demonstrated in service its dependability and stability. Production of standardized units to fill a substantial backlog of priority orders is now in progress. Write for further data and priority information.

AIRTRONICS Manufacturing Company

★ *Division of Aerocrafts Corporation* ★

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SPECIALISTS IN CONVERTING PLASTICS TO WAR
LEADERS IN POST-WAR PLANNING, TOO

Climaxing Cruver's famous wartime achievements, which represent a complete range of plastics and production techniques, we take time out from war to remind you that our experience has enriched our engineering and production knowledge the better to serve you *post-war*.

We are at the service of all industries in planning their custom molding and fabricating.

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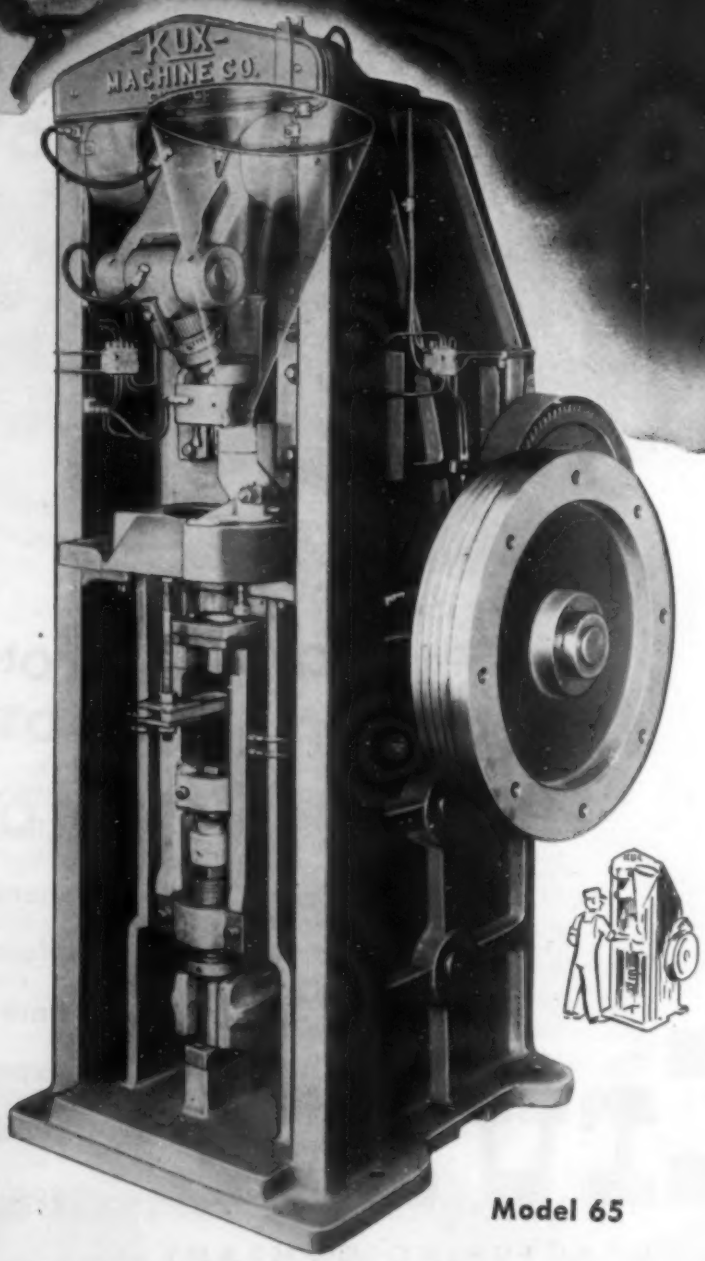
Kux Preform Presses

THE NEW MASSIVE MODEL 65 PRODUCES PREFORMS 3" DIAMETER, HAS A 3" DIE FILL AND APPLIES 75 TONS PRESSURE

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.



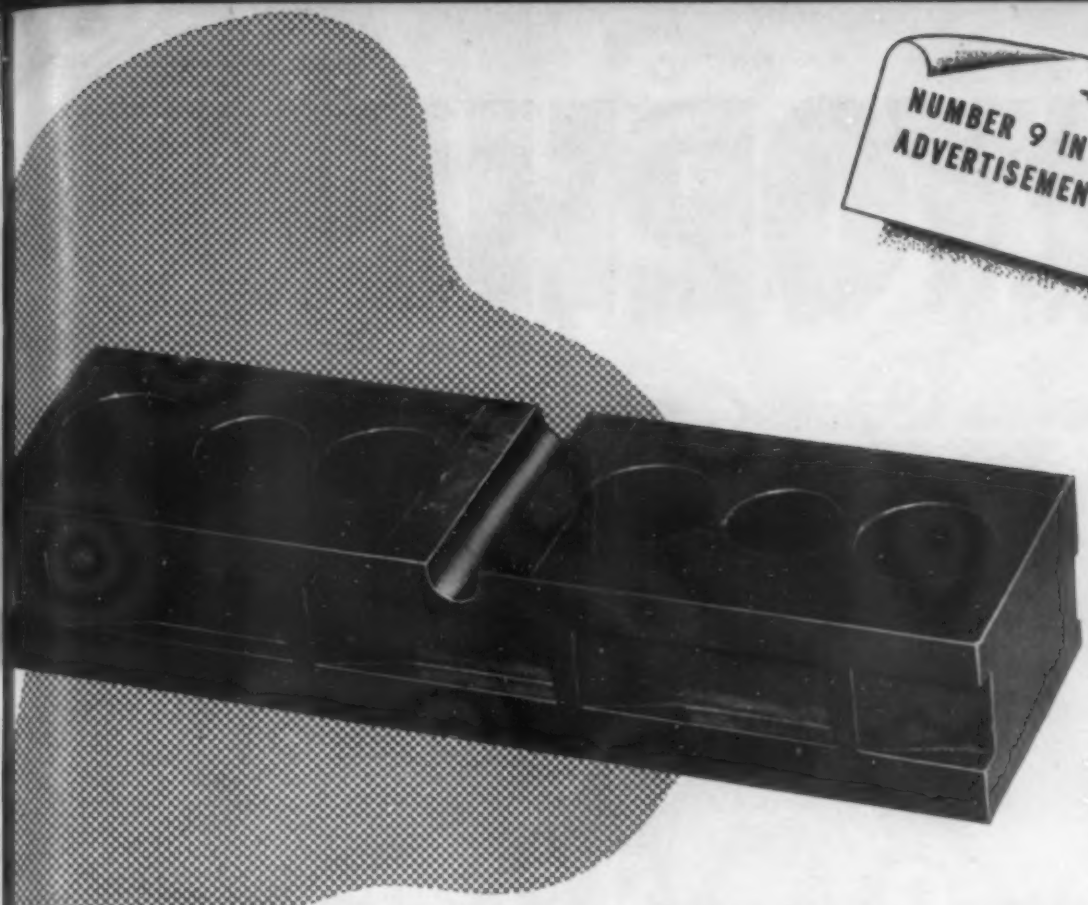
Model 65

KUX MACHINE COMPANY

3924-44 W. Harrison St., Chicago

● Write Dept. P for catalog or demonstration

NUMBER 9 IN A SERIES OF EDUCATIONAL ADVERTISEMENTS ON TRANSFER MOLDING



CURED THICK CROSS-SECTIONS

Heavy sections of thermosetting plastics present no difficulties to the TRANSFER molder. The TRANSFER MOLDING process insures complete filling of the mold cavity, regardless of cross-sections, and uniform cure throughout each piece. This is achieved by reducing the resin to a molten state before it is pushed into the mold for setting.

TRANSFER MOLDING is especially adapted to turning out molded articles of higher and more uniform density by reason of its special handling of materials. Also it insures a closer cohesion between resin and filler, to eliminate internal weak spots or external flaws.

TRANSFER MOLDING's ability to produce thick, perfectly-cured sections has played an important part in war production. It will, of course, be available to all industries in peacetime.

TRANSFER MOLDING is the best way to

Handle inserts—metal, glass, ceramic
Mold high-impact materials
Mold unsupported cores
Achieve maximum dimensional accuracy
Reduce trapped gases
Lower mold costs
Lengthen mold life
Increase molding speed
Reduce finishing costs
Improve uniformity of cure regardless of cross-section
Save material by eliminating flash
Get practical solution to difficult molding problems

—on thermosetting plastics.

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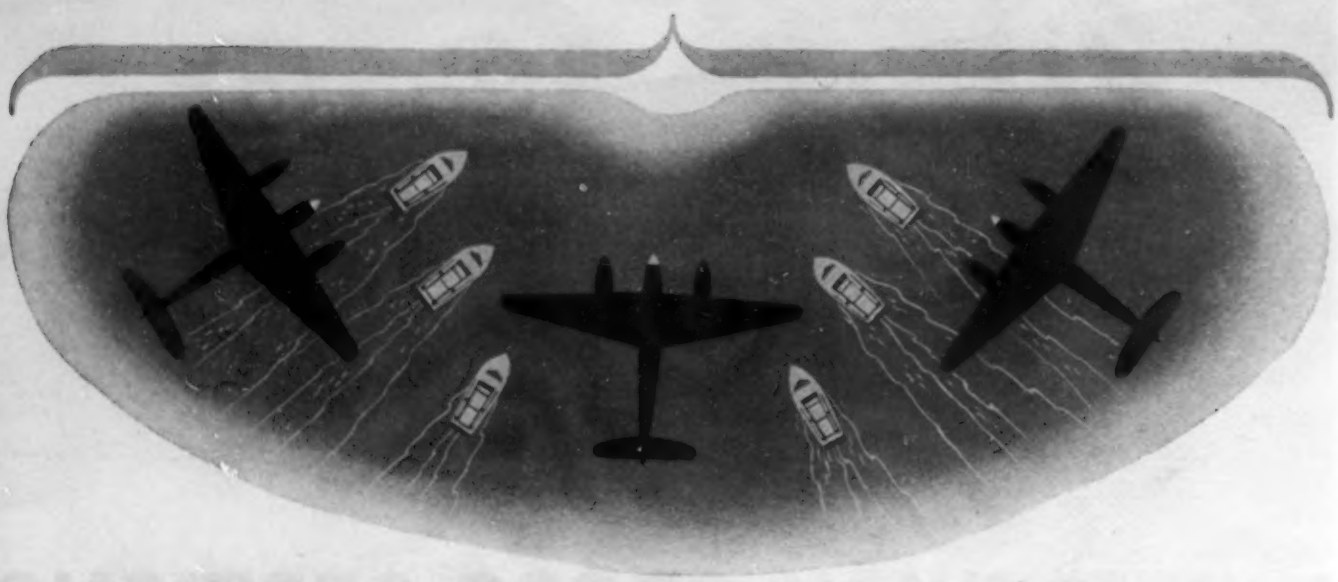

plugs a dangerous gap in the laminating field

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Together with the quantity production of these important new synthetics, RCI—America's largest producer of synthetic resins—offers customers the services of its experienced research personnel, *and has recently become an important source of essential phenol.*

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RIDE WITH MACOID EXTRUDED ELASTOMERS

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Profile illustrated embodies extruded elastomeric plastic, special "MACOID 320" Vinyl, to replace rubber for all extruded sections. This material has better aging qualities than rubber and is resistant to oil, greases, gasoline, acids, alkalies. THIS IS ONLY ONE OF SEVEN applications of "MACOID 320" on this particular vehicle.

Our engineers are specialists in substituting plastics for rubber, with especial emphasis on automotive applications. They have also pioneered many other applications of the extruding process for refrigeration, furniture and war industries. We do injection molding, too.

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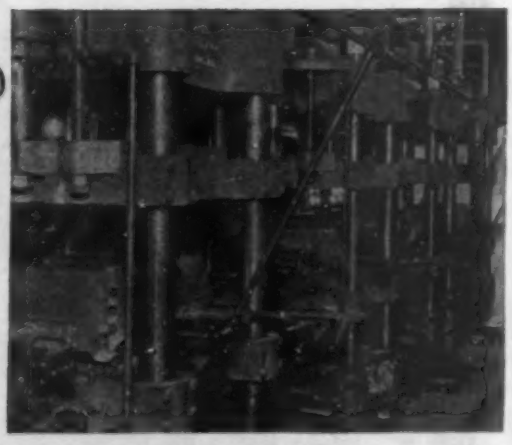

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Barco Swivel Joints are used on all kinds of hydraulic machinery, cylinders, die heads, rolls, platens, etc., under suction or pressure.

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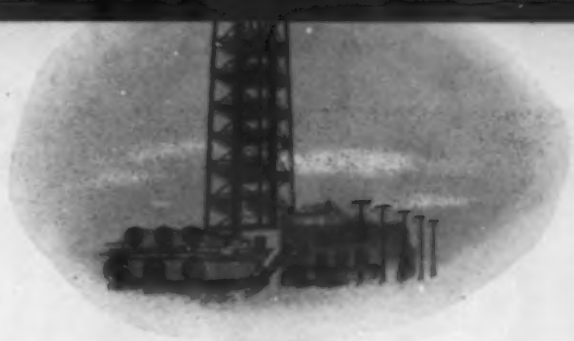

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In a move of far reaching significance to the entire plastic industry, Dow announces a reduction in the base price of Styron (Dow Polystyrene)—from 30¢ to 27¢ per pound. The new low price, at which you may now obtain this strategic plastic from its source, is made possible by improved and vastly increased production.

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STYRON

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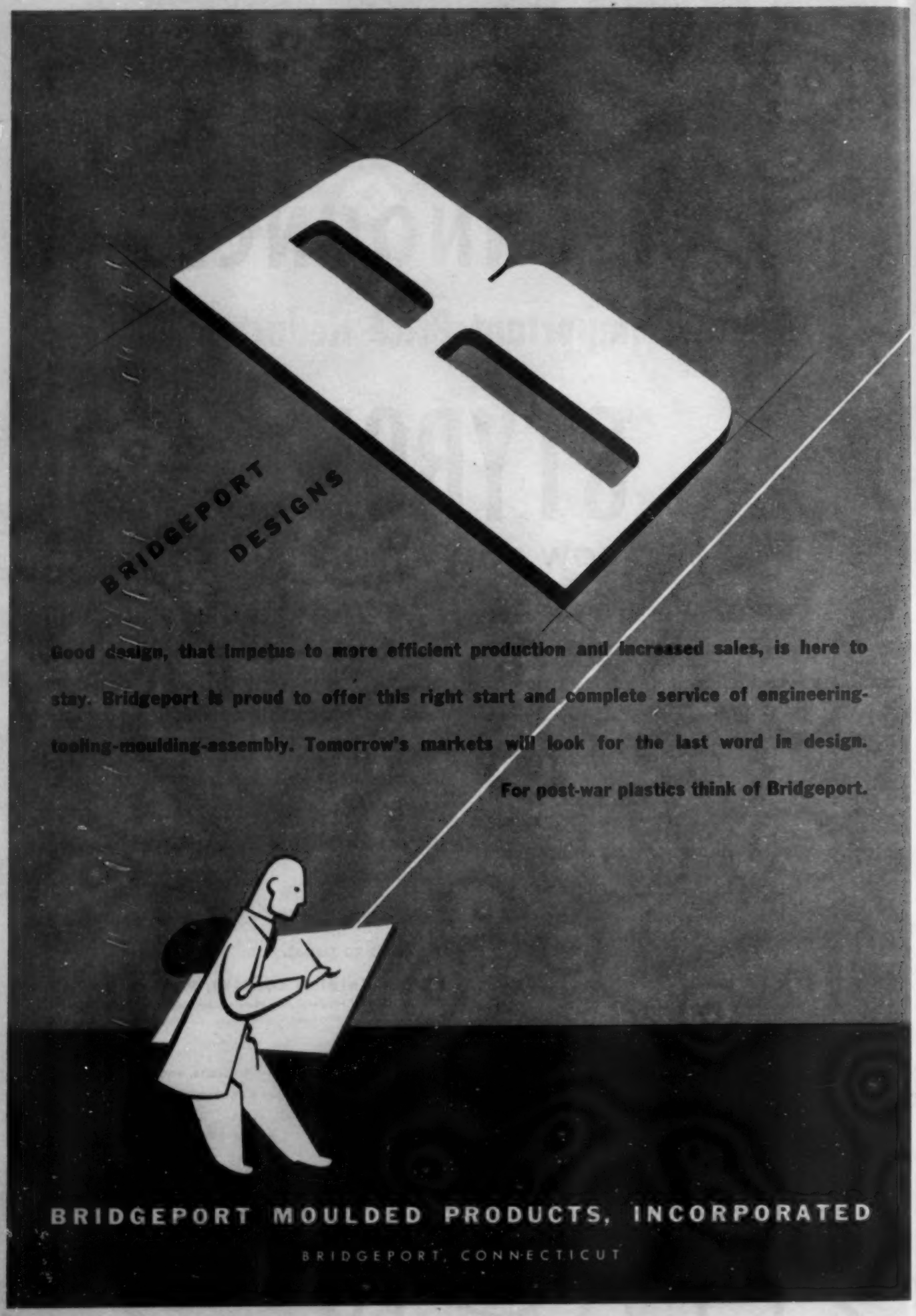
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Good design, that impetus to more efficient production and increased sales, is here to stay. Bridgeport is proud to offer this right start and complete service of engineering-tooling-moulding-assembly. Tomorrow's markets will look for the last word in design.
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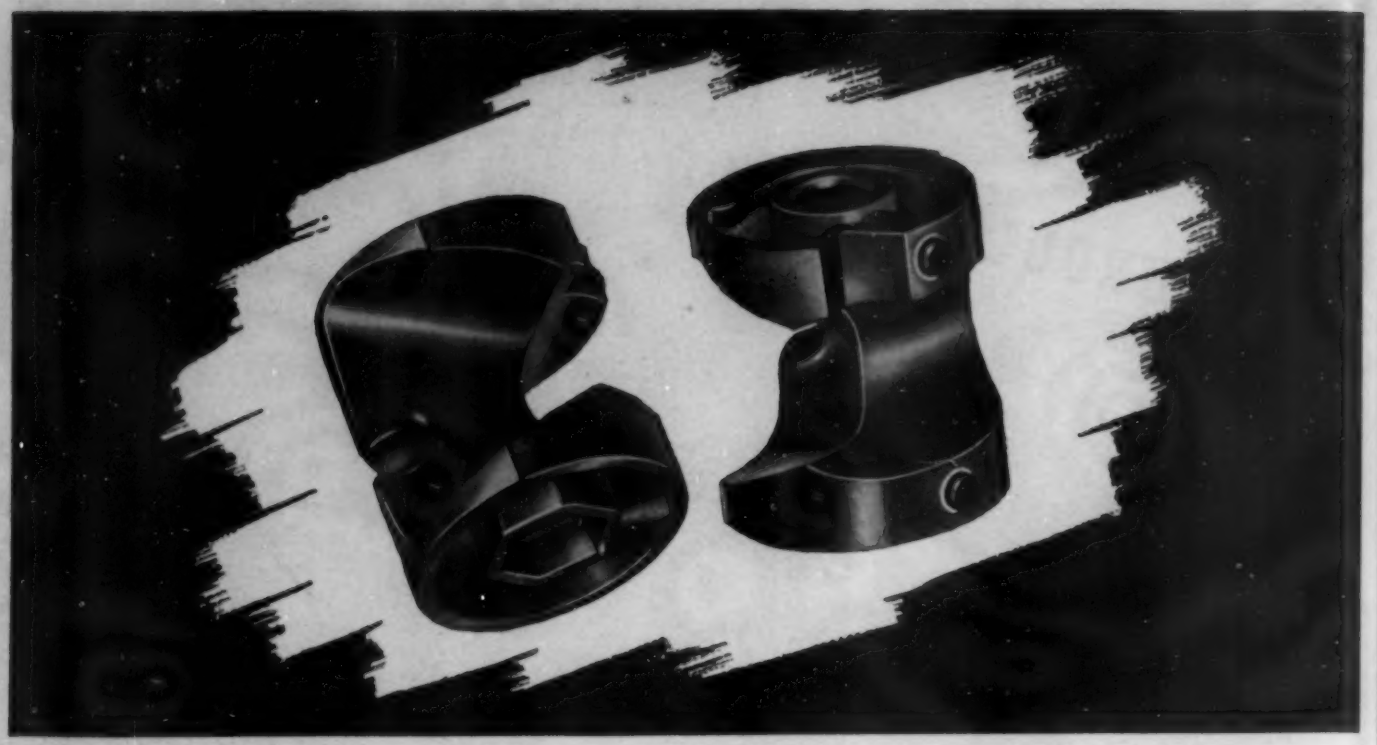
On V-Day, war-proven Valinite will return from the battle fronts to serve America in the building of a better tomorrow. Already on the designing boards of today are compact bath and kitchen units . . . modernistic furniture and luggage . . . streamlined cars and homes . . . and many other products as different and exciting as the wonders in the land of Lewis Carroll's imagination. The world of tomorrow will enjoy all these things when America's factories and industries produce for peace, again.

We're hard at work now supplying our armed forces with products made of Valinite — the new low-pressure reinforced plastic. But we are planning for tomorrow when Valinite will take its place in a peacetime world. When that time comes, look to Valinite to do a BETTER plastic construction job in new, modern products for happier, more comfortable living. Our Postwar Planning Bureau will be glad to help you with your problems. Call on us at any time.



Again — A MOLDED PLASTIC "SUBSTITUTE"

. . . BETTER THAN THE ORIGINAL

It's happened many times. And it illustrates an important fact. *In many unusual applications, molded plastics are doing a better job than the original materials.*

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But here's the interesting part. While originally a wartime substitute, this plastic valve has proven so satisfactory that Evinrude plans to continue using it and other molded plastic parts in future models.

Here at CMPC, doing the unusual . . . and doing it well . . . is a habit of long standing. It's gained us a national reputation for quality and service. If you're planning a postwar job . . . or have what it takes in the way of priorities for immediate production . . . write for a CMPC Development Engineer. There's no obligation.

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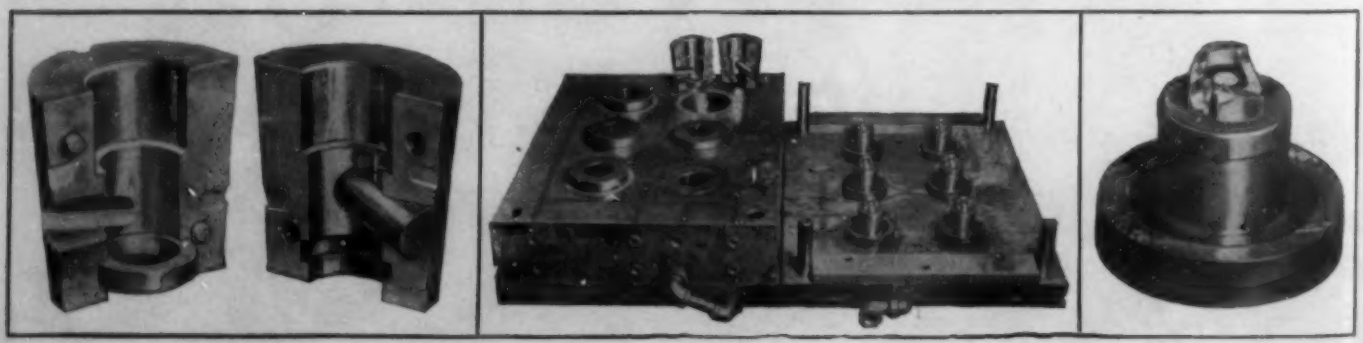

Photo U. S. Signal Corps

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NEW MACHINERY AND EQUIPMENT

★ THE MACO FEATHERWEIGHT SWITCH, PRODUCED by Metalfic Arts Co., Cambridge, Mass., is now available in a design that is said to meet requirements for economy of critical materials and to provide performance adequate to the needs of postwar industrial development. The frame of this new switch is molded of high-impact phenolic. A further advantage understood to be derived from the molded plastic frame is increased rigidity and complete uniformity of switch elements resulting in the assurance of continuous smooth operation. Knurled inserts are provided on $^{5}/_{8} \times 1^{1}/_{2}$-in. centers and are locked in place so they cannot twist or pull out. Coin silver contacts carry 10 amp. AC or 2 amp. DC at 115 volts. Contacts may be ganged in any desired number and combination and for locking or spring-return in either lever position.

★ ACHIEVING A COMPLETE INSPECTION DEPARTment at the point of work, the DoALL Mobile Inspection Unit manufactured by Continental Machines, Inc., Minneapolis, Minn., is said to bring into effect savings of thousands of man-hours and the prevention of waste. This unit, which can be wheeled close to the point of work on any job, occupies little more than an area 24 × 42 in. and contains a complete precision department. Gage blocks, gaging instruments and a comparator are provided. Precision gage blocks having an accuracy of ±.000004 in. are listed by a calibration chart for height, flatness and parallelism. Included also are 20 different precision measuring instruments, among them being calipers, trammel points, center points, scribers, base blocks, gage holders of 2, 6, 9 and 12-in. capacities, vernier gage block, master square, sine bar, straight edges, master flat and a 12 by 24-in. precision surface plate. The accuracy of these instruments after wear, dirt and rough handling, can be checked by use of the optical flats and monochromatic light.

★ A SIGNALLING TIMER, SERIES S, DESIGNED TO command visual and audible attention the instant a time interval is completed, has been perfected by Industrial Timer Corp. of Newark, N. J. It provides for the automatic closing or opening of a circuit at the elapse of a specified time. When the pointer

on the timer is manually set to the required interval shown on the dial, a circuit is closed which operates a pilot light indicating the time has started. At any point during the interval, the exact time elapsed is shown on the dial. An audible alarm sounds at the finish of the period and the pilot light goes out. Additional lights or alarms may be connected, and a change-over wire and terminal is provided at the rear of the case. It can be readily attached to any wall or standard switch box. The size is 5 × 5 × $3^{1}/_{2}$ in. deep. The timer operates on alternating current, 115 to 230 volts; 25, 50 or 60 cycles, 1000 watts.

★ THE IMPROVEMENTS AND REFINEMENTS OF THE new Dillon portable tensile tester, manufactured by W. C. Dillon & Co., Inc., Chicago, Ill., will prove interesting to those engaged in testing materials. This tester is said to obtain the required control data more simply and economically, enabling many

materials to be analyzed rapidly for relative strength. Although it starts at 0–250 lb. and has 7 intermediate and interchangeable indicators up to 0–10,000 lb., the machine weighs but 132 lb. and is only 35 in. tall. The new holder-design for standard V-wedge serrated grips is designed to permit the tester to handle great loads, and the grips allow for rapid specimen insertion. The machine, which is hand driven, can be motorized with ease. It may be obtained with metal floor cabinet, specimen space, and room and shelf for motorizing.

★ HIGHLY EFFICIENT AS A DEGREASER AND CLEANing medium, Penetone, made by the Penetone Co., Tenafly, N. J., is said to contain no chemicals on the WPB allotment list and to do a better job easier than most other cleaning mediums. It comes in 2 formulae: the standard Penetone, which is suitable for most light degreasing jobs, as well as for general maintenance; and "Penetone Senior," recommended for use on heavy oils and caked-on greases. "Major," another Penetone product, is suggested for use in very heavy duty degreasing. These preparations have a wide variety of cleaning uses, e.g., on floors, garage and grease racks and the chassis and wheels of trucks and automobiles. They offer complete safety from fire hazards and injury to operators.

★ TO OVERCOME THE PROBLEM OF SLIPPING ENcountered in drilling, countersinking and tapping small precision parts, Mead Specialties Co., Chicago, Ill., has developed the "Flat Top" Work Holder for holding small flat work in place. Any type of job, varying in thickness from a few thousandths of an inch up to several inches, and in area from the size of a dime up to several inches square may be secured by this fixture as long as it is flat on the bottom. One of the supporting plates, perforated and provided with 3 studs, is used for milling and shaping the work. Two studs are set in position to locate the back of the material, and the third is set at the end to support it against the pressure of the cutting tool. The "Flat Top" is actually used as a universal jig and can be changed from one setup to another simply by dropping three studs into the three holes. Adjustment for work thickness is made by turning the head of the ball-joint stud.

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BOOKS AND BOOKLETS

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Hand book of Plastics

by Herbert R. Simonds and Carleton Ellis, assisted by M. H. Bigelow

D. Van Nostrand Co., Inc., New York, 1943

Price $10.00 **1110 pages**

The authors' objective in outlining and preparing this book was to provide a comprehensive reference work that would treat of the details of the subject in one volume. It contains nine major sections, as follows: Introduction, Physical Properties, Materials, Manufacture, Processing and Fabrication, Chemistry, Applications, Commercial Considerations, and Appendix, Glossary and Bibliography.

The book brings together under one cover information which has appeared in various books, magazines and company literature. This has the outstanding advantage of convenience in locating such data through the very complete index. However, it sometimes presents a very confusing picture because of inconsistencies in the material obtained from different sources and be cause the rapid advances in the plastics field have made the information incomplete or out of date. For example, the chapter on testing methods is based principally on A.S.T.M. methods approved through 1941, whereas today some of these have been revised and many others have been approved and published. Similarly, materials and technics in the plastics industry have been characterized by major changes and developments during the war, but this period is not covered in this book.

Many parts of the handbook will be very useful for reference purposes, such as the sections on solvents, plasticizers, synthetic coatings, analysis of plastics and the miscellaneous data tabulated in Part IX. Its preparation has been a stupendous task. To make it a useful and valuable tool in the development of this dynamic industry, as hoped for in the preface, provision will have to be made for frequent revisions.

One of the authors of this book was a pioneer in the plastics industry. The name of Carleton Ellis will long be remembered for his prolific patent record in various fields, including resins, particularly of the urea and alkyd types, and for his many outstanding books, especially "The Chemistry of Synthetic Resins." His plans to participate in completing another contribution to the reference literature on plastics were unhappily brought to an end by his death early in 1941. Its completion under trying circumstances by the two co-authors and a 15-man advisory board enlisted from the industry is a fitting tribute to the soundness of the original plan. G.M.K.

The Chemical Front

by William Haynes

Alfred A. Knopf, New York, N. Y.

Price $3.00 **264 pages**

If the author had limited himself to a presentation of chemistry's rôle in helping us wage the present conflict, his book would still rank as one of the year's most important contributions to popular scientific literature. In addition to being a skilled writer and one of America's foremost chemical economists, Mr. Haynes is interested in certain national and social implications of scientific progress. He is concerned, first of all, that we shall not be caught again with half the chemical supplies we most need snugly tucked in the enemy's pocket. Another danger which he cautions against is that of permitting the potentialities for postwar employment and abundant living which chemical advances have placed within our grasp to be stifled by governmental interference. In support of his argument he stresses the fact that private capital's investment in chemical projects is "patient money"—so patient that it will wait from 5 to 15 yr. for the achievement of a new compound which might never have seen the light had its development been financed by public funds or subjected to hostile lobbying activities.

Plywoods

by Andrew Dick Wood and Thomas Gray Linn

Chemical Publishing Co., Inc., Brooklyn, New York

Price $4.00 **363 pages**

Although it was written primarily for the trade, this survey of the plywood industry also will interest architects and builders, and many layman readers. The book is divided into 8 main sections which cover the background of the industry; physical properties of wood and plywood; the manufacture of multi-ply; laminboards, blockboards, composite boards and specialties; grading, testing, packing and storing; plywood-producing countries of the world; the development of wall panelling; plywood applications.

Industrial Radiology

by Ancel St. John and H. R. Isenburger

Published by John Wiley and Sons, Inc., New York, 1943

Price $4.00 **298 pages**

How many molders now have equipment for radiographic inspection of that daily stream of products upon which is staked their livelihood as well as their reputation? It is anticipated that with plastics entering into industrial applications more extensively in the post war period, the presence of such apparatus, particularly of the fluoroscopic type, will be the rule and not the exception. The primary purpose of industrial radiology is to assure soundness of material and perfect workmanship, a worthy goal for any craftsman. Positioning and defects of metallic inserts can be determined easily today; improvements in technic will extend the usefulness of this inspection tool to detection of abnormalities in the structure of the plastic material itself. This book on the practical aspects of industrial radiology is recommended to executives and engineers who wish to look and plan ahead for this new phase in the inspection and testing of plastics. G.M.K.

★ CHICAGO METAL HOSE CORP., MAYWOOD, ILL., has published an illustrated engineering manual (SS-44) on Rex-Flex stainless steel flexible tubing. Characteristics of the product are shown in detail with tables of sizes, weights, wall thicknesses. The booklet also includes pressure data, minimum bending radii and complete information on fittings.

★ NEW USES FOR SYNTHETIC RESIN GLUE AS A vital war material are described in a new booklet published especially for builders, contractors, architects and engineers by I. F. Laucks, Inc., Seattle, Wash. Illustrations are used to show how waterproof glues are employed in the construction of airplanes, ships and buildings. All types of the Laucks' line of glues are described, and a section is included on the company's wood preservatives. *(Please turn to page 176)*

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WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

What about plastic parts for refrigerators and irons?

Plastics operators should be interested in recent Government announcements concerning the possible manufacture of such things as electric irons and refrigerators for civilian consumption. Plastics molders and laminators are particularly concerned because manufacture of any large number of either electric refrigerators or irons would ordinarily require a good sized quantity of plastic parts. Already we have received queries from molders asking if we could ascertain the attitude of the Chemicals Bureau officials toward allocation of polystyrene and phenolic compounds under these circumstances. Before answering that question it is necessary to clear up the situation regarding possible manufacture of irons and refrigerators.

It is true that the Requirements Committee of WPB has approved a program for 2,000,000 electric irons, but no order for their manufacture has yet been given. The Government is looking ahead to the time when manufacture of electric irons for civilian consumption may start, but no one is willing to state when that date will be set. Present plans, still subject to change, are like this: Quotas for each manufacturer will be assigned on a base year production. Each manufacturer will then be investigated to ascertain whether or not production of irons would interfere with production of war goods in his plant. If the investigation shows that the war program might be impeded in any one plant, that particular manufacturer would be given the option of farming out his quota of irons to someone else or of turning back his quota to WPB. The farmed-out quota would carry the trade mark of the original manufacturer.

The refrigerator situation is a bit confusing because of a recent announcement that almost 270,000 ice refrigerators for civilian consumption were going to be permitted and quotas have been assigned to about 30 manufacturers. These particular refrigerators are strictly non-mechanical and supposedly contain almost no plastic parts.

The best information we can gather on mechanical or electric refrigerators is that all plans are still in the "talk" stage. Confusion over this situation no doubt exists because there has been a great deal of talk about how to proceed in case restrictions were lifted. During the course of this preliminary planning many figures have been bandied back and forth including possible quotas for various manufacturers. Those same manufacturers have, in turn, asked their suppliers what could be done about supplying plastic parts. As a result of all this questioning the word has gone around that orders for electrical refrigerators were actually in the works. This is a false assumption. Apparently the Government is not going to lift the restrictions until the European campaign is well under way.

Under those circumstances it seems a bit premature to discuss what the Chemicals Bureau may do when the time comes to allot plastics materials for use in civilian refrigerators, or even irons. However, since the question keeps bobbing up, we shall attempt a curbstone view with the distinct understanding that it is strictly unofficial, and we reserve the right to change our mind later.

Chemicals Bureau officials seem acutely conscious of their responsibility to make plastic components available when they can be used advantageously. But they know that plastic was sometimes substituted for metal during the emergency simply as a replacement. They believe it unwise to continually use plastic as a substitute in any job where metal is again available and is obviously better suited than plastic. However, no alert commodity specialist wishes to see the material for which he is responsible withheld from sound uses, provided that such use does not interfere with the war effort or indispensable civilian requirements. Officials dare not be caught short of vital material needed for war production and are in no such enviable position as the aluminum or steel people who can talk about cutbacks and even possible surpluses.

As an example of their possible action, take a molder who might want polystyrene to mold plastic breaker strips, handles, doors and other parts for electric refrigerators. Polystyrene, like phenolic materials, is limited by the terrific war demand for benzol. Benzol is needed in ever increasing quantities for the high-octane gasoline program. It is also a necessary ingredient for styrene and phenol. WPB must determine how the supply shall be allocated to be most effective in the war effort. It is a safe bet that they consider high octane gasoline for aviation and styrene for rubber more important than polystyrene for civilian refrigerators. The last 2 months' allocations indicate that they have already eliminated polystyrene allocations for most civilian items which were formerly allowed. That elimination will probably continue for at least 90 days.

Present circumstances may soon change, and polystyrene or phenolic allocations for refrigerators might well be assumed as of more importance than some other civilian items. Indeed, it is not at all improbable that allocations for marginal items might be curtailed and the material thus gained allocated to refrigerators. Again, we are emphasizing that this is speculation—WPB simply will not be pinned down to an inflexible pattern and changing circumstances rapidly alter their decisions.

Plastics operators must give their individual attention to these fast developing rumors and stories concerning civilian goods production. Every story or rumor should be carefully confirmed by responsible authorities before individual action is taken. It is quite possible that agency A may announce that certain devices are about to be placed in production without having consulted agency B and it may happen that agency B controls component parts of the device. Without those parts the device cannot be manufactured. When agency A finds that it cannot get the necessary parts, the device program for civilian production is left hanging in the air until agency B finds a way to provide the missing parts.

An example might be the very refrigerators talked about in this article. If one agency decrees that metal may be released for refrigerators, what are the manufacturers going to do for refrigerant or paint which in most cases is an alkyd modified urea? Both the refrigerant and type of paint needed are tight. The same thing applies to the insulation on cord required for electrical household equipment. Until the missing refrigerant for refrigeration or insulated cords for irons can be supplied, the manufacturing program will be hung up somewhere along the road. Of course, the danger in this situation is that the missing parts may be allotted to a competitor of plastics, but all we can report at the present is that the Chemicals Bureau officials are aware of this situation.

Vinyl scrap for coatings in tight control

There seems to have been an erroneous impression spreading through the trade that WPB has abandoned control measures on vinyl-resin-coated "seconds" such as hospital sheeting and raincoats. A check with WPB officials indicates that there is no intention to abandon these controls. Every pound of vinyl resin that can be found is needed, and coated-fabric scrap is not to be thrown around willy-nilly to end up in civilian items when it was intended for military purposes. Vinyl manufacturers are still

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required to report their vinyl-coated-fabric scrap totals to WPB, and must designate the purchaser and use of every pound sold.

E. A. Wilson joins Plastics Unit

Elbert A. Wilson of Longmeadow, Mass., and formerly with Monsanto Chemical Co., has joined the Plastics Unit of the Chemicals Bureau as a technical specialist. After serving with Monsanto Chemical Co. for 15 years as Director of Research, Development, Technical Sales and Chemical Control, he was retired by the Plastics Division last January. During World War I, Mr. Wilson was on the staff of E. I. du Pont de Nemours and Co., Inc., and served at Hopewell and Arlington where he was Director of Research. He has also had considerable experience abroad.

Plastic dollars on the make

The output of plastics and resins during 1943 amounted to $300,000,000 according to an estimate by WPB just published in "Domestic Commerce." According to the Bureau of the Census, the product valuation for plastics and resins in 1939 was $78,000,000.

Fabricated plastic products were manufactured to a value of around $280,000,000 according to WPB's estimate as printed in "Domestic Commerce." This compares with the $71,900,000 output in 1939. Eighteen companies operating 29 plants in 1943 turned out a progressively increasing volume of business for plastics materials, as indicated by the following breakdown, by quarters:

First quarter, $64,627,000. Second quarter, $66,490,000
Third quarter, $70,902,000. Fourth quarter, $76,000,000.

Many plastics people will also be interested to know that plywood has jumped from 160,000,000 sq. ft. in 1925 to an all-time high of more than 1,800,000,000 sq. ft. in 1942. Except for wartime restrictions which held 1943 production to 1,500,000,000 sq. ft. last year's output would have reached or passed the 2,000,000,000 mark, according to the Commerce Department's news release.

Smaller War Plants Corporation announces new loan policy

A new loan policy has just been adopted by the Smaller War Plants Corp., which raises the amount that banks are permitted to carry under a deferred participation to $250,000 from the former limit of $100,000, where the bank takes a direct participation in the loan of 10 percent or more. Interest at the rate of 6 percent annually is permitted on that part of the loan which the bank carries at its own risk. On the balance, carried under a deferred participation, interest of 4 percent is charged, with the bank paying the SWPC a graduated fee of one-half of 1 percent a year, depending on the percentage of the bank's participation.

In announcing this new policy, Maury Maverick, chairman of SWPC, predicted that the small manufacturer will be able to secure financing more quickly and it will allow his continued dealing with the local bank. In turn, the bank will be able to service its customers on loans which otherwise may have been beyond its legal limits. Mr. Maverick said that "it brings into even closer harmony the banks of the country and SWPC, which have been working hand in hand to aid small business." Details of this new procedure may be obtained at the nearest SWPC field office.

Sixty materials changed in materials substitutions and supply list

The WPB on Feb. 2 issued the latest materials substitutions and supply list which contained about 60 changes in materials. In contrast to the transfer of copper and steel to the less critical commodities of Group II, most chemicals and plastics have become tighter since the previous materials list was announced. In announcing this new list, WPB conservation division emphasized again that the classifications apply only to basic raw materials and that in spite of the easing of steel and copper, this does not necessarily mean they are more available in all forms and shapes.

The three materials categories will remain the same. They are as follows:

Group I—Insufficient to satisfy war plus essential industrial demands
Group II—Sufficient to satisfy war plus essential industrial demands
Group III—In excess of current essential needs

The following is a list of specific changes: From Group II to I: cellulose acetate, phenolic resins, acrylic resins, ethyl and isopropyl alcohol, chlorine, rubber synthetic general purpose G.R.M., calcium carbide.

Who's got the button?

Printed press reports indicate that some acetate button molders are disturbed over an allegation that they are not getting their share of the acetate plastic allocations. This veiled charge of discrimination against acetate button molders is not justified by facts. As far back as early fall WPB officials were conscious of the inflated demand for acetate—including button material. They dug into an industry spot check for 1942 and found that the button business alone accounted for 2,400,000 lb. of acetate during that entire year. In the fall of 1943 requests for orders amounted to 800,000 lb. a month or twice the 1942 volume. Obviously this was inflation on a non-essential, or in some cases, perhaps a marginal item.

Consequently a questionnaire was mailed to the thermoplastic button molders about Nov. 15 asking the following questions:

1. How much thermoplastic powder did they use on textile buttons in 1942?
2. How much thermoplastic powder was used for all purposes during the entire year?
3. How much nitrate was used for buttons?

The questionnaire should have reached all molders within at least 5 days. The allocation for all cellulose acetate material was completed by Nov. 27, which gave button molders at least 5 days to answer their questionnaire. Only a part of them had responded, but it did not seem fair to penalize those who had answered as well as the delinquents. To meet this dilemma WPB set aside 200,000 lb. of acetate flake for buttons—a figure based on 1942 business—and intended to allocate it among the various molders proportionately according to their 1942 business.

While waiting for the balance of the questionnaires to come in, a strike cut off a large portion of the butyl alcohol supply from which plasticizers are made. On Dec. 4, the allocation of butyl alcohol was recalled and alternate materials for plasticizers were recommended as a substitute wherever possible. As a result it became necessary to re-allocate phthalates and other plasticizers for cellulose plastics. In the face of these difficulties WPB did take care of the requests for cellulose plastics on the December interim allocation.

Most of the material manufacturers adapted their processing to meet the crisis with most amazing ingenuity so that January interim allocations could be sent out based on 1942 production figures. But a few of the button molders complained bitterly about the substitute materials. Probably they had no idea that a strike in Peoria could cause all this turmoil in the acetate button business. These same button molders also complained because their competitors were allegedly obtaining acetate by overstating their capacity and through the black market. They asserted that "spot checks" were no preventative for overstating capacity. The answer is that WPB has never made a spot check for this purpose—no inventories have been examined. The only checking has been on the suppliers' customer orders as reported on form WPB-2947 (formerly PD-602). Furthermore it should be noted that allotments are, and will be based on base-period usage and not on the capacity of the molder.

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NEWS OF THE INDUSTRY

WILLIAM H. THEILE

★ IT IS WITH PROFOUND REGRET THAT WE LEARN of the death of William H. Theile, President of Catalin Corp. His passing is a loss that will be felt by the entire industry.

Mr. Theile took over the active Management of the Catalin Corp. in the fall of 1931. Although he had many other interests, he devoted a large part of his time to the plastics industry. He was vice-president of both the Plastics material manufacturers' Association and the Atlantic Investment Corp.

★ THE WATERBURY BUTTON CO., WATERBURY, Conn., will now be known as The Waterbury Companies, Inc.

★ SALES OFFICES HAVE BEEN ESTABLISHED FOR Franklin Plastics Div., Robinson Industries, Inc., under the following men: J. M. Waldecker, 401 N. Broad St., Philadelphia, Pa., and William H. Wadsworth, 55 West 42nd St., New York, N. Y.

★ WILLIAM J. COLVIN HAS BEEN APPOINTED PLANT manager of the Camden, N. J., operations of the Monsanto Chemical Co. He succeeds John J. Heck who has retired after being in the business for more than 50 years. Wilfred M. Adey will become technical assistant to Mr. Colvin.

★ CRUVER MANUFACTURING CO., CHICAGO, ILL., announces the appointment of Clarence Vredenburgh as general manager, W. T. Osborn, Jr., as auditor and comptroller, and George Weber, as superintendent of production.

★ EUGENE R. PERRY, MANAGER OF WESTINGHOUSE Electric and Manufacturing Co., Pittsburgh, Pa., recently announced the appointment of three men to new posts in the Trafford Micarta Department. They are David R. Rennie, superintendent; Henry C. Guhl, engineering manager; and Joseph E. Callahan, application manager. All will be located at the Trafford plastic plant.

★ R. B. TUCKER, FORMERLY DIRECTOR OF GLASS sales with the Pittsburgh Plate Glass Co., has been elected a vice-president of the company. In this position, Mr. Tucker will continue to direct airplane assembly sales, plastic developments, and the export and optical departments.

★ THE ARMY-NAVY "E" AWARD HAS BEEN CONferred upon the Columbian Rope Co., Auburn, N. Y., and all its employees. This award is in recognition of the Company's work in supplying the Armed Forces with rope, fibre products, plastics and aircraft parts.

★ ANNOUNCEMENT HAS BEEN MADE BY HERCULES Powder Co., Newark, Del., of the appointment of George A. Paine as district manager of the Synthetics Dept. for the New York territory. Paul L. Lefebvre is in a similar capacity in the Chicago Territory.

★ ANNOUNCEMENT IS MADE OF THE APPOINTMENT of H. W. Catt as manager of the chemicals and pigments department of the purchasing division of the B. F. Goodrich Co., Akron, Ohio. He succeeds Dr. Victor E. Wellman who becomes director of purchases in the Company's newly created chemical division. Other appointments in this division are: William I. Burt, as general manager of plants, Dr. Frank K. Schoenfeld, as director of the technical and development sections, and Harry E. Foster, as general auditor.

★ ANNOUNCEMENT IS MADE OF THE FORMATION OF the Livingston Plastics Corp., 1431–1435 West Hubbard St., Chicago, Ill. President of the new company is Charles C. Livingston; vice-president in charge of sales, K. Livingston; vice-president in charge of engineering, Emil Ibach; secretary, Frank J. Hoope.

★ FORMICA INSULATION CO. IS INSTALLING NEW treating equipment involving the infrared principle of heating which will increase capacity to use raw materials for fabrication between 20 and 25 percent. Orders for Army Ordnance have necessitated the increased capacity, which in turn will probably call for increased manpower.

★ GRASSELLI CHEMICALS DEPT. OF E. I. DU PONT DE Nemours and Co., Inc., Wilmington, Del., announces a new process for producing anhydrous hydrogen chloride which offers definite advantages over other known methods. With the use of chlorosulfonic acid this process produces the acid at greater than 99 percent purity, without explosion hazard. A single control is sufficient, and installation requires only standard materials of construction. Advantages include lower investment in installation, low operating cost, and the production of a usable by-product, sulfuric acid.

★ A NEW PLASTIC, 1421 CAST ROD, WHICH HAS THE ability to withstand very high temperatures without melting, has been developed by the Plastics Divisions of General Electric Co. Its high dielectric strength, low power factor and low dielectric constant have led to its successful use for applications in the radio industry where other plastic materials have proved unsatisfactory.

★ "THE FORMICA STORY," A 5-REEL MOTION PICture in color, accompanied by narration, had its premier in New York City early in February. D. J. O'Conor, president of Formica Co., Cincinnati, Ohio, producers of the film, said that the showing was for representatives of the metropolitan daily press, industrial publications and radio stations, leaders in the laminated plastics and collateral industries, and special guests. The picture tells the factual story of the history of Formica, its manufacturing and fabricating processes and its diversified applications.

★ WILLIAM T. STOPFORD HAS BEEN APPOINTED A metropolitan representative of the Boonton Molding Co. Because of his merchandising experience with R. H. Macy and Co. and Montgomery Ward, Mr. Stopford is particularly fitted to handle postwar sales plans of the company.

(Please turn to next page)

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★ A NEW TRANSLUCENT "SKIN" FOR PROTECTING machine parts in shipment has been developed recently by Dow Chemical Co., Midland, Mich., in response to an appeal from a maker of amphibian vehicles. According to Army Ordnance men, the material shows indications of relieving another bottleneck in the flow of new and replacement parts to the battlefronts. The product, which has an ethyl cellulose base, is a plastic-like substance which is applied by a simple hot dip process, sets in a few seconds into a tough, skin-tight coat that fully protects the metal from rust, corrosion and dirt during shipment. Assembly crews find that the material strips off quickly and easily with no more equipment than an ordinary pocket knife.

★ ATLAS POWDER CO. HAS ESTABLISHED A CENTRAL research laboratory near Wilmington, Del., according to a recent announcement by K. R. Brown, director of research. The new laboratories are designed to allow for necessary extension of research programs vital to the war effort and to relieve the crowded conditions of present facilities. The present director of the Atlas Research Laboratory at Reynolds, Pa., also will be in charge of the new laboratory.

★ AT A RECENT MEETING OF THE BOARD OF DIRECtors of Pittsburgh Plastics Engineers Society, Dr. E. P. Perry of the Westinghouse Electric and Manufacturing Co., was elected president. Other officers elected by the Board were Dr. R. W. Quarles, Mellon Institute, vice-president; W. M. Wilson, Mine Safety Appliances Co., secretary; and D. D. Monroe, Thompson & Co., treasurer.

★ ALFRED FRITZSCHE, ONE OF THE LEADING INdustrialists of Cleveland, and chairman of the board of General Industries, Elyria, Ohio, died on January 19, at the age of 74. One of Mr. Fritzsche's sons, Allan Fritzsche, was recently elected president of General Industries, Inc.

★ ANNOUNCEMENT HAS BEEN MADE BY CHEMICAL Research for Industry, Inc., that James W. Yanda has been appointed General Manager in charge of Research Chemical Development Engineering.

★ TO SUPPLEMENT THE RESEARCH WORK OF THE Allied Chemical and Dye Corp. and its operating subsidiaries, a research branch, designated as Central Research Laboratory, will be established in Morristown, N. J.

★ KENNETH H. RENAU HAS BEEN APPOINTED MANager of the Louisville, Ky., distributing unit-warehouse of U. S. Mengel Co. and U. S. Plywood Corp., which was formed as part of their postwar plywood expansion sales program involving the opening of a chain of plywood distributing units, of which the Louisville warehouse is the first.

★ RALPH L. WILSON, FORMER CHIEF OF THE CONstructional Steels Section, Metallurgical and Conservation Branch, Steel Division of WPB, has been appointed chief metallurgical engineer of Timken Roller Bearing Co., Canton, Ohio. Prior to his work with the Steel Division of WPB, Mr. Wilson spent 10 years with the Steel and Tube Division of Timken Roller Bearing Co. as metallurgical engineer.

Sorry!

★ In the article "Sabotaging the Saboteur" which appeared on pages 106 and 107 in the January 1944 issue, credit for the equipment used in the production of the tamperproof passes was erroneously given. Fred S. Carver is the manufacturer. The material used at Wright Field for badges and passes is uncoated cellulose acetate. (*Please turn to page 178*)

SPEECHES OF THE MONTH

★ AT A MEETING OF THE LAKE STATE SECTION OF the Technical Association of Pulp and Paper Industries, L. Klein, Resinous Products & Chemical Co., delivered a talk on "Synthetic Resins for the Paper Maker." Mr. Klein described briefly the major synthetic resin groups, covering their commercial development and possible application to the paper industry. His list included phenolic, alkyd, vinyl, acrylic, urea and melamine-formaldehyde type resins, and a generalization of other types of resins. According to Mr. Klein, resins to be useful in paper manufacture must have the following characteristics: 1) they must be water soluble or water dispersible; 2) they must lend themselves to application in the usual paper-making operation; 3) they must be odorless and colorless, tasteless and non-toxic; and 4) the cost should not be such as to increase excessively the cost of the finished product. Resins which have shown the greatest usefulness in the paper industry to date are the urea-formaldehyde and melamine-formaldehyde types, and these are the products that have found the widest commercial application and give indication of increasing importance. The talk contained a discussion of Uformite 466, a product of these resins which has found application in such diverse types of paper as toweling, blueprint tag stocks, bag and wrapping papers, tissue papers and many other items. In conclusion, Mr. Klein stated that the most important use of synthetic resins in paper making so far is in the development of wet strength. Increased dry strength, fold resistance, etc., have also been obtained, and the future will see substantially improved paper. The use of resins will be an important factor in this development.

★ "THE DESIGN AND MERCHANDISING OF PLASTIC Proprietary Items" was the subject discussed by R. H. Cunningham, Hemco Plastics Div., Bryant Electric Co., at the monthly group meeting of the New York chapter of The Society of the Plastics Industry. Mr. Cunningham stressed 8 points in the successful merchandising of plastic proprietary items. They are: 1) be sure that your proprietary department is a separate department; 2) have a fairly complete line of related items. Selling cost can be kept to a minimum if these are kept within one type of distribution; 3) do not get too technical in design or hesitate to get ideas and help from the consumer market; 4) watch manufacturing costs; 5) try not to copy other products, since copying calls for underselling or very definite improvement. Don't be afraid to bring out an entirely new line; 6) select the proper type of distribution; 7) watch your packaging; and 8) give good service to your customers. Carry a sufficient stock of your standard items so that you can make delivery within three or four days.

★ "PLASTICS FOR THE COSMETICS INDUSTRY" WAS the subject of an address delivered January 26 to the Scientific Section of the Toilet Goods Association by Burton E. Cash, engineer in charge of Molding Material Development for Plastics Div., Celanese Corp. of America. Mr. Cash stressed the importance to manufacturers of a sound understanding of the chemical and physical characteristics of the various plastics, and the forms in which they are available, so that a logical choice of material can be made and the success of the item to be manufactured insured.

★ FRANK HARTMAN OF THE CANADIAN RADIUM and Uranium Corp. addressed the Plastics Institute Alumni Association, Philadelphia chapter, at its December meeting. Mr. Hartman's subject was fluorescent, phosphorescent, and radium luminous compounds as applied to plastics. (*Please turn to page 176*)

THE ACID TEST

A tough test . . . and a tough appraiser—the specimen's got to be the real "McCoy"!

The same goes for dies and molds—they've got to have what it takes! If their steel surfaces are not hard-chromium-armored, their performance will be quickly devalued by the corrosive action of plastic acids, production and the gritty elements with which their operating parts come in constant contact.

The thinnest shell of I. H. C.* extending over contours and into grooves, forms a protective front to destructive influences and projects perfect performance far beyond a die's estimated life span.

One way of making sure you will get your money's worth out of the mold that's headin' for a long run, is to first head for I. H. C.*

*Industrial Hard Chromium

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

15 ROME STREET • NEWARK, NEW JERSEY

ALL PHOTOS, COURTESY FORMICA INSULATION CO.

1

New quarters for the engineers

EVEN before its doors are opened to the visitor the Engineering Department at the Formica Insulation Co. gives evidence of its work. When a wing was added recently to the company's main plant to accommodate the Engineering Department, the applications of laminates began at the entrance where the fire doors which separate the new section from the old are fabricated of $^{5}/_{32}$-in. thick Formica wallboard attached to both sides of a Kalamein door core.

One basic type of laminate, $^{1}/_{16}$-in. sheets veneered to a plywood core, is used for all applications throughout the new wing. The wall material for private and general offices; drafting, blueprint and conference rooms; and the rest room was fabricated in 36 x 72 x $^{7}/_{8}$-in. thick panels scored to assimilate 36-in. squares. These panels were applied directly to wood furring strips and wood grounds which previously had been attached to the masonry walls. All means of fastening the panels to the walls is concealed by a progressive system of tongue and groove joints.

The upper surfaces of the walls in this wing and all office partitions are finished in a light shade of warm tan while the dado is a medium shade of the same color. The one exception is in the rest room where walls, partitions and doors are a neutral grey-green color. To carry out the uniform color scheme all desk tops and other horizontal surfaces such as file cabinets, reference table tops, window stools and counters are finished in a dark grey.

Ribbon Prima Vera Realwood was used for the walls and interior of the partitions in the office of the chief engineer. Here the same material, designed with a herringbone pattern of grain, covers the wall immediately behind the desk. Both the executive table and workdesk are made complete with Claro Walnut Realwood. In the conference room Ribbon Prima Vera Realwood was used for doors and conference table.

Adding a final touch to the comfort of the company engineers are air conditioning units set into the walls at scattered points throughout the wing. The adjustable exhaust grills and the diffusing baffles on the air supply duct in this system all are made of $^{1}/_{4}$-in. solid Formica sheet.

1—A corner of the drafting room showing walls covered with 36 x 72 x 7/8-in. thick panels. 2—A glimpse into the chief engineer's office. 3—Exhaust grills and diffusing baffles set into ceilings are made of 1/4-in. solid sheet

2

3

WANTED—AN IDEA

for use in manufacturing rigid or semi-rigid plastic containers

What we are looking for—Somewhere there is an idea for an *article*, or a *process*, or *equipment* that would be used in a process, associated with the manufacture of rigid or semi-rigid plastic containers and possibly, collapsible tubes.

The idea that would best fit our purpose is one that can be developed by our technical and laboratory staff, and which will engage the resources and ingenuity of our manufacturing and production departments.

Perhaps you have ideas about impregnated paper for processing containers directly from pulp. You may know how to form containers directly from pulp, eliminating the step of forming a flat stock before processing. Or your idea may deal with an entirely different material or process. In any event, we would be glad to hear from you.

Who we are—We are a self-contained division of one of America's successful corporations—a name you would instantly recognize.

Today, our division is engaged solely in war work. We are looking ahead to post-war activity in Packaging, with special attention to containers made from plastics.

The management group within our division has a successful record in (1) chemical research, (2) engineering and inventive experience, (3) production, (4) merchandising and marketing.

Hence we are in a position to develop the full possibilities of the idea we select. Ample financial resources are available for research, development, production, and marketing. We have a modern factory group of two plants available for our purpose.

We invite your suggestions and ideas, with the full assurance that they will receive careful analytical consideration.

MANUFACTURER, Box 943, c/o Modern Plastics, 122 E. 42nd St., N. Y. 17, N. Y.

Fittings and tubings

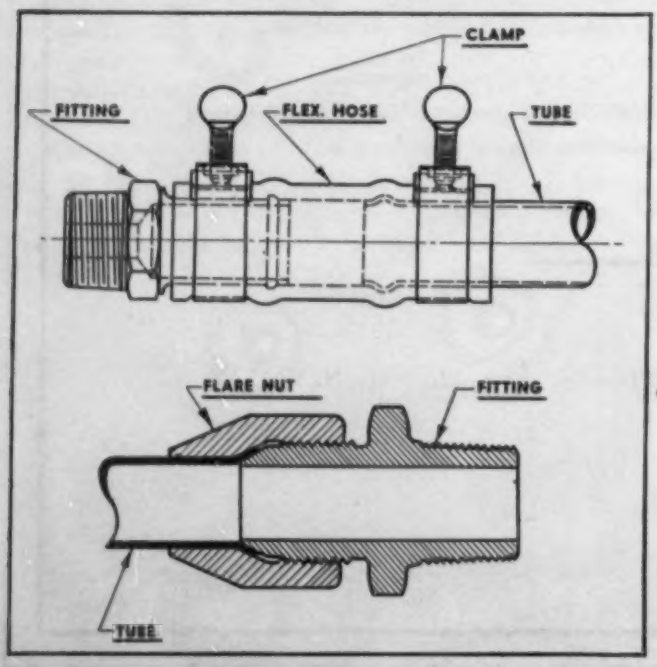
(*Continued from page 124*) is 100 p.s.i. at 180° F. Figure 7 shows the extent to which the tubing has been pressure-tested. It will be noted that the 100 p.s.i. value is quite a conservative limit. No increase in this figure is contemplated until better materials are available. Another desirable improvement in tubing would be increased resistance to such fluids as alcohol and aromatic fuels.

With plastic tubing, as with fittings, procurement is the major advantage in wartime. This is possible, of course, because of simplicity and widespread facilities and the better supply position of the material. Another feature is that plastic tubing forms so easily and rapidly that 50 percent of time is saved over that required to form aluminum tubing. The methods of flaring and beading the plastic tubing were illustrated in the previous report.[1] Figure 8 shows an assembly of the beaded coupling with hose and clamps. Flexible hose is slipped over the bead with sufficient overlap to permit the application of a clamp. The bead is a standard safety measure to prevent the hose from slipping off after the clamp is tightened. Figure 9 shows an assembly of flared tubing and fittings. The flare angle of the tubing is formed to match the cone of the fitting. Both types of connections are used in aircraft. The fitting-type connection is preferred for higher pressure and quick disconnect. The hose coupling is a vibration arrestor and permits a greater tolerance in tube makeup.

In peacetime the two major advantages will be: 1) the time saved in forming and 2) the fact that the tubing is transparent and, therefore, permits visual inspection for bubbles, air pockets and the like. Incidentally, transparent tubing is specified not only for visual inspection of operations but also to reveal any defects which might occur in the extruding operation. Since the weight saved by using plastic tubing is only about 5 percent, weight can hardly be considered an important factor in the use of plastic tubing unless it is possible to develop a tubing which has increased strength as well as the other desired characteristics that will permit the reduction of wall thickness.

The last item to be considered in this discussion of plastic tubing is that the present figures show a possible cost saving of approximately 25 percent in the consumer's price as compared to aluminum and copper tubing. This should be interesting to all consumers.

8—The drawing at the top shows an assembly of the beaded coupling with hose and clamps. 9—The sketch at the bottom shows an assembly of flared tubing and fittings



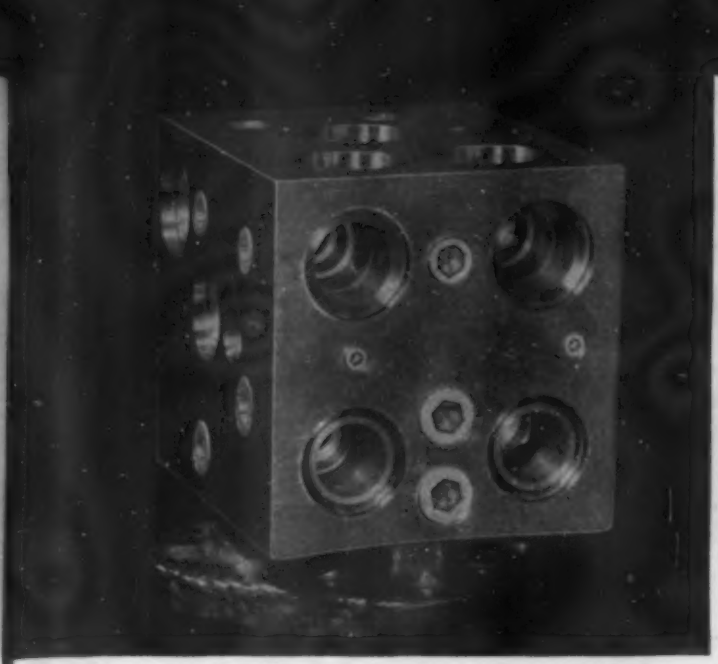
Future for these plastics

Although the Army is still conducting tests on these plastics and has not approved them, they are being used to some extent for certain applications at the discretion of the user. It is also our understanding that at least one branch of the Canadian Air Forces is interested in the possibilities of these fittings and tubings. However, it is not believed now that the war effort will benefit very materially by these plastics unless the Government Departments concerned approve their use on applications where they are satisfactory.

The part these standard plastic fittings and tubing will play in future production will depend upon the continued interest and support of the plastics industry. Acquaintance with the requirements and objectives of the program plus the present interest of the plastics industry should result in products which have the opportunity of reaching far into the aluminum fitting and tubing field. It is believed that with the present rate of development of more suitable materials, plastic fittings will eventually affect the use of aluminum fittings 90 to 100 percent in aircraft as against the present limits of approximately 20 percent of possible applications. This is an illustration of the development yet to be carried out.

In fields other than aircraft, the fittings and tubing will be available for use in household and stationary refrigerators, washing machines, automobiles, etc. The thought is not only of the prewar equipment designs. The average engineer is bubbling over with ideas of things to develop and produce after the war. Super convenience will be the factor in household and other appliances—the super-convenient kitchen, the super-bathroom, the refrigerator with automatic ice cream freezing units and ducts to other compartments in the vicinity which require cooling. Air-conditioning systems in the home will be as common as the refrigerator is today. Hydraulically operated and controlled items not heretofore dreamed of by the consuming public, will be installed in the home. No doubt all such accessories in the future home will be the built-in type, and plastic fittings and tubing should play a very important part in making these things practical. Hydraulic control and indicating systems should compete with electrical systems in this respect since they will not require much, if any, municipal inspection. Public utilities, the factory and the farmer should also benefit greatly by the conveniences provided through the use of these plastics. There is every reason to believe that these fittings and tubings will be available in the mail order houses, the retail hardware store and the plumbing shop.

This is the position of the National Aircraft Standards Committee on this program: To establish standard guides and procedures as they apply to aircraft, based on the most popular standard now in use. Such work is similar to the establishment by the Society of Automotive Engineers of the SAE thread series except that the NASC work usually applies only to aircraft. This does not mean that the work of the NASC cannot be utilized by other industries, but simply that the standards thus established are based on aircraft standards. The NAS plastic fittings project is an example of cooperation and coordination with other indus-



BORING 8 MULTIPLE DIAMETER HOLES

—at one setting—with 30% SAVING IN TIME

• • ANOTHER EXAMPLE OF THE TIME-SAVING, PRECISION PERFORMANCE OF THE AUTOMETRIC MODEL B

(Photos and performance data courtesy of C. B. COTTRELL & SONS CO.) Milwaukee, Wisconsin

Take a good look at the work-piece shown above—a centrifugally-cast steel unit requiring the precision boring of a total of 8 holes — 5 of them with multiple diameters and 3 holes (2 with 1½ inch diameters, 1 with 1¾ inch diameter; 7½ inches long) which must be held to within .0002 on the diameter throughout the entire depth.

Sure, it's a tricky job but a "natural" for the Autometric Model B Precision Jig-Boring Machine. The piece was rough drilled before being brought to the Autometric where it was finish bored to specifications—at one setting—with a 30% saving in time over other methods.

Such fast, precision performance is possible on the Autometric Model B because it is the only jig-borer, with a built-in rotary table, capable of boring holes on all sides of a work-piece *at one setting.*

Many shops consider the Autometric Model B as indispensable equipment for fast, precision boring of a wide variety of parts and pieces.

Autometric Model B Features:

★ Errorless measuring — more rapidly, more accurately — by the Autometric method.
★ Infinite variation of spindle speeds by fingertip control.
★ Infinite selection of feeds by fingertip control.
★ Hardened — ground — super-finished steel ways.

Write for complete information on the Autometric Model B Jig-Boring Machine.

Rotary Head Milling Machine
•
Autometric Jig Borers
•
Center Scope

Kearney & Trecker Products CORPORATION
Milwaukee, Wisconsin
Subsidiary of Kearney & Trecker Corporation

Milwaukee Face Mill Grinder
•
Milwaukee Midgetmill
•
Milwaukee Speedmill

tires. It indicates the desire of the NASC to make its guides available to all who wish to use them, without royalties or commissions. Any person or organization who desires to manufacture, sell or use these standard parts may do so without obtaining permission. The NASC would, however, be concerned and opposed to any change of design or decrease in the standard of quality. On the other hand, the improvement of quality is permissible and welcome.

The control of this program after dissolution of the Plastic Fittings Project Committee is a point for further consideration. The NASC will, of course, handle the aircraft end. However, it is not believed that the NASC will be in a position to handle any of the conditions arising from usage by other industries. It has been suggested that some appropriate organization take over these duties and coordinate its actions with the NASC. Such duties would be to print and distribute detail drawings from originals supplied by the NASC, to record all manufacturers and users, to distribute periodic reports of each list, and to receive complaints of under quality and take necessary action. Other details could be worked out satisfactorily.

I would like to express appreciation on behalf of the NASC, the Project Committee and the Douglas Aircraft Co., to the various technical representatives of the plastics industry for their generous contribution, and to the Western Plastic Molding Co. and American Specialties Mfg. Co. for supplying test samples. Special credit goes to the Modern Plastics Co. for their contribution of tests and methods of manufacture of both fittings and tubing, especially in the forming, bending and flaring of the tubing. To a great extent this molding firm is responsible for making this project possible.

Shear strength of plastics

(*Continued from page 120*) pressive strengths were determined in accordance with Federal Specification L-P-406.

Discussion of results

Experimental results are given in Tables I and III. The averages were obtained from tests on 5 to 10 specimens. Some of these data are shown graphically in Figs. 5 and 6. The average ultimate shear strength of the thermosetting plastic materials ranged from 4400 p.s.i. for transparent, unfilled allyl-derivative plastic material to about 12,000 to 18,000 p.s.i. for the various laminated phenolic paper- and fabric-base plastic materials. The shear strength of the thermoplastic materials ranged from 2400 p.s.i. for a cellulose acetate material to 10,000 p.s.i. for polyvinyl chloride-acetate.

Using the Johnson jig, higher shear values were obtained with a decrease in thickness of the thermoplastic materials. Since the other properties of the different thicknesses of each material were comparable, the differences are attributed partly to the test method. The thermoplastic materials deform considerably in compression during the shear test before the ultimate load is reached as compared to thermosetting plastics. Because of the greater ratio of bearing area to shear area the thinner sheet deforms less before the ultimate load, and there is less compressive yielding or crushing. It is believed that the higher shear values obtained on the $^1/_{16}$-in. thick sheet are more indicative of the true shear strength. The thermosetting plastic materials exhibited no appreciable deformation before the ultimate load, and there were no significant differences in the shear values obtained between the various thicknesses.

Table IV.—Shear Strength of Laminates at 45° Angle to Longitudinal Direction

Material	*Thickness, in.*	*Average shear strength at 45°, flatwise, p.s.i.*
Cross-laminated glass- and cotton-fabric-base phenolic	$^3/_{16}$	21,400
Low-pressure allyl-type resin, glass-fabric base, cross-laminated	$^1/_8$	13,900
Parallel-laminated fabric-base phenolic, Grade L	$^1/_8$	13,400
Parallel-laminated fabric-base phenolic, Grade C	$^1/_8$	12,700
Parallel-laminated paper-base phenolic, Grade XX	$^1/_8$	11,600

All specimens were loaded until fractured into three separate pieces. Most of the filled materials showed relatively smooth separation planes whereas most of the unfilled materials showed jagged irregular surfaces, shattering in some cases into several pieces. It should be noted that due to insufficient material the effects of type of jig and thickness of specimen were not investigated for the phenolic laminate containing glass- and cotton-fabric filler—the only material for which all the layers were not the same filler.

It was observed that shear strength was higher edgewise than flatwise on the phenolic laminate prepared with high-strength paper base. However, there was no significant difference for the phenolic-resin-impregnated laminated compressed maple. Shear strength parallel to the laminations (condition *A* or *B*, Fig. 1) is much lower than for other directions for laminated materials. The shear strengths of the various fabric- and paper-base phenolic laminates were about 50 to 70 percent of the compressive strength. The shear strengths of the various fabric- and paper-base allyl-type low-pressure laminates were about 80 to 130 percent of the compressive strength. The shear strengths of all but one of the thermoplastic materials (polystyrene) were about 70 to 100 percent of the compressive strength. These relationships are not considered very significant, however, as in general there was no specific correlation with compressive or tensile strengths.

Shear at 45°

Matériel Command tests have shown that for cross-laminated glass-fabric-filled laminates for which the tensile and compressive properties in the longitudinal direction were substantially equal to those in the transverse direction, these properties at 45° were very much lower. Tensile strength dropped about 50 percent and compressive strength about 25 percent of the longitudinal values. The shear strengths on 45° plane, however, are 10 to 15 percent higher than longitudinally. These characteristics do not apply to the usual cotton-fabric- and paper-filled laminates, the tensile properties at 45° being intermediate between the two principal directions and the compressive strengths being substantially the same in all three directions. The shear strengths on 45° planes of these materials are intermediate between those on longitudinal and transverse planes. However, all three are substantially equal. Results of a few shear tests at 45° on some of the laminated materials of the present

. . . What Then?

ON some future date a bombardier's finger will press the release that will send hurtling down the last bomb of this war. No finger of fate could be as historically significant . . . for that finger will have pressed the release that will start the greatest reconstruction and world-wide development in the history of mankind.

Yet, the groundwork for that reconstruction is already being laid! For the experience industry has had in meeting military precision requirements will have a permanent effect, since it will impose the highest standards of quality on every type of product and make the utmost efficiency in production imperative for profitable operation.

Then will the pattern for war production become the pattern for peace production. Then will the newer methods and materials be placed at the command of peacetime industry. Then will McAleer consolidate with industry, its advanced finishing knowledge, improved finishing methods and quality-controlled finishing materials where they will do the most good in the perfection of plans for a great new era of production.

Peace, when it comes, will last for only a few minutes of whistle-blowing and bell-ringing. Then the green light will flash on for all-out peacetime production and prosperity. Will you be ready? We will.

The accelerated uses of Plastics when Peace comes will demand that you have a source of technical finishing information on which you can depend—If your war or postwar products have base material listed below, let McAleer Men, Methods and Materials help you finish the job.

PHENOL-FORMALDEHYDES • UREA-FORMALDEHYDES • ACRYLATES and METHACRYLATES • STYRENES • HARD RUBBERS
CASEINS • ETHYL-CELLULOSES • CELLULOSE ACETATES • CELLULOSE ACTETATE BUTYRATES • CELLULOSE NITRATES

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investigation are given in Table IV. These were made on sheets of 1/8 or 3/16 in. thickness as indicated, loaded flatwise, using the Johnson shear jig.

Conclusions

1. Shear values of various thermosetting plastics obtained on sheets of 1/2, 1/8 and 1/16 in. thickness, using the Johnson jig, were comparable. These values were in turn comparable to those obtained with the 3-place jig on 3/8-in. diameter pins machined from the 1/2-in. thick material.

2. Shear values of various thermoplastic materials obtained with the Johnson jig increased with decreasing thickness for 1/2, 1/8 and 1/16-in. thick material. The values obtained on 1/2-in. thick material were comparable to those obtained with the 3-plate jig on 3/8-in. diameter pins machined from the same material. The differences are due probably to the higher ratio of bearing to shear areas for the thinner sheet specimen—resulting in less deformation occurring in compression. The higher shear values are considered nearer the actual shear strength.

3. Shear values were not greatly different for both longitudinal and transverse shear planes of laminated phenolic materials—paper- and fabric-filled—which showed marked directional properties in tension, although the compressive strengths were almost comparable in both directions.

4. There was no specific correlation between shear strength and compressive or tensile strength.

5. For the determination of the shear strength of thermosetting plastic materials of any thickness, the test procedures specified in Federal Specification L-P-406, employing either a 3-plate jig or a Johnson-type shear jig, are satisfactory. For thermoplastic materials, the test procedure specified in Federal Specification L-P-406 should be limited to the Johnson-type shear jig only, using thin sheet specimens not over 1/8 in. thick.

The spreader method

(Continued from page 105)

A drawback common to all compreg remains with all of the above examples. The compressed panel must be cooled before the pressure is released, otherwise severe surface damage results. Release without cooling and without damage to the panel was found possible when the following technique was adopted. Birch veneers 1/20 in. thick were dried to a volatile content below 0.1 percent. A concentrated liquid phenolic resin[3] was applied on the spreader; the veneers were immediately assembled and pressed under 2000 p.s.i. at 320° F. The pressure was released with the panel at this temperature. The panel had a smooth surface and a uniform specific gravity of 1.22.

The properties of compreg may be varied during the manufacturing process to attain specific characteristics. Therefore, it should be produced to suit the requirements of a particular group of uses. The virtues of the new spreader method become particularly striking when applications other than propellers are considered. Cost of manufacture by the conventional impregnation method does not vary greatly with species or resin content, since it is mainly due to the cost of handling veneers and redrying, together with that of solvents (alcohol) lost in drying. By the new veneer coating method, compreg may be made in any grade, from any species and at any resin content, at costs bearing a reasonable relation to the qualities required. Continuous use of fresh resin insures greater uniformity from batch to batch. Cross-ply material which promises to be competitive with common corrosion-resisting metals has been made from Douglas fir, using a low resin content and relatively low pressure (Table I, Sample 9). Experimental marine stair-treads made from this material have attracted great interest because of their hardness, toughness, relative lightness, low cost, and resistance to corrosion and wear.

The data included in Table I show that by the new method compreg can be made that is in all respects the equal of that made by the standard procedure. Compare Samples 1 and 4 which are aircraft quality and also Samples 2 and 5.

[3] 98 percent reactive solids.

Suggested redrier for use with new process

Difficulties have been experienced in drying on conventional machinery veneers coated on both sides with liquid resins. The partially dried resin has a tendency to adhere to the rolls or other equipment used to support the veneers, with consequent fouling and possible damage to the veneers themselves. This trouble, it is believed, may be eliminated by reducing the area of contact between veneer and support to points or lines. A suitable drier may consist of a heated chamber through which the double-coated veneer travels upon a support consisting of two or more sprocket chains to which are attached blunt pins or narrow bars, the veneer resting on these and having no direct contact with any other part of the mechanism. Warping may be prevented by using two sets of such supports, the veneer lying horizontal between them. Pin chains similar to those used in preparing hard cordage fibers for spinning would be suitable. By this means adhesion of support to veneer would be so reduced that the dried coated veneers could be removed rapidly at the dry end. If such a drier were placed in tandem with the glue spreader, handling of wet veneers would be altogether eliminated and the over-all handling reduced substantially.

Corrosion resistance of new-type compreg

Compreg made by the technique described above has extraordinary resistance to corrosion by acids. A sample containing 26 percent phenolic resin made by coating a mixture of 4 parts of resin BR-15100 and 1 part of resin XC-16529 upon 1/16 in. birch and, after brief drying, compressing the assembly at 320° F. under 2000 p.s.i. to a specific gravity of 1.38, was immersed to half its depth in a solution of copper sulfate containing 75 g. per liter free sulfuric acid. After three weeks at 120° F. no damage was observed.

Dense-faced plywood

Hard-surfaced wear-resistant paneling may be made by hot-bonding a single veneer, previously impregnated with resin BR-15100 and redried, to untreated core plies, under sufficient pressure to compress the impregnated ply—densification of the face and bonding to the core plies taking place simultaneously. The core retains its normal density. Such dense-faced plywood was made more simply by coating one veneer of natural wood with a penetrative resin (resin BR-15100) and bonding this to the core plies with a non-penetrative bonding resin (resin XC-16529, dissolved in 1.1 parts water), at 320° F. and 125 p.s.i. pressure. The method was successfully applied to poplar, the face plies being 1/28 in. in thickness. Cure cycle required at 310° F. was 10 minutes.

Dense-faced plywood has been suggested for floors and wall paneling, and for other uses where a wear-resistant surface on a resilient core is desired. It has a high gloss and is resistant to heat, scratching and alcoholic liquids. These prop-

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THE METAPLAST GUILD is doing a 100% War Job . . . producing thousands of aeronautical and electronic parts and, of course, all to the Army and Navy ultimate - in - precision specifications . . . such as only Metaplast can deliver.

HOW YOU CAN APPLY THE METAPLAST PROCESS TO YOUR BUSINESS . . .

1. Have a Metaplast Guild member in your vicinity metal plate your plastic parts and items for you. Present day war work or post-war planning are of equal interest to the Guild.

2. Apply for membership in the Metaplast Guild . . . as a member you can Metaplate your own fabricated parts.

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erties should be of great value in furniture, especially in table tops and similar structures. Since the finish is produced in the hot press, laborious polishing operations are eliminated.

Postwar possibilities

The simplicity, economy and flexibility of the new method promise many postwar uses for compreg. Its freedom from warping and swelling suggests its use in door and window frames and sills in better-grade homes. Hardness gives resistance to wear and scratching, of importance in tops for desks and other furniture, chair rungs and backs, door- and stair-treads. A permanent gloss may be imparted during the compression, thus eliminating the need for subsequent finishing. The gloss so imparted resists damage by wear, hot objects and alcoholic liquors which soon ruin ordinary applied finishes. Table tops of compreg will, therefore, render excellent service in restaurants and home kitchens. An appealing feature of compreg is that the valuable properties are gained while the attractive appearance of the wood is fully retained, indeed enhanced.

Skis edged with compreg resist wear and damage by ice. Compreg of medium density may replace teak for boat decking. In pianos the pin-boards holding the tuning pegs, if made of cross-plied compreg of medium density, would be expected to permit retention of tuning longer than when made of ordinary plywood—the present practice.

Compregnated wood, being hard and dense, turns and machines readily. Lamp bases, door knobs, drawer pulls, novelty items such as paper weights, ink stands, ash trays, brush and comb handles, bowls and dishes for domestic use and tool handles may be made in this way. Toilet seats and subway turnstile bars are but two other items of interest.

Other cases where hardness and appearance are the important features include working surfaces that receive hard usage—sewing machine tops, workbench tops, school desks, bar and store counter tops and fronts. The metal plates customarily used at the foot of store doors to prevent marring by contact with shoes may be replaced by compreg with improvement in wear and appearance. Instrument panels and cases of compreg combine hardness, toughness, freedom from warpage and excellent electrical properties.

A number of industrial products may take advantage of the unique properties of this interesting material—bed plates for heavy motors, loom spindles, bearings and paddles for wet operations in paper and textile mills, especially in dyehouses. Station wagon bodies may be constructed of a compreg frame and resin-impregnated (uncompressed) panels to gain additional strength and weather resistance. Compreg also combines shock resistance with excellent electrical properties, and reference has already been made to its resistance to corrosion. Because of its insulating properties together with its resistance to moisture and rotting, compreg should prove of great value in iceboxes and refrigerating compartments.

Paper-base laminates

(*Continued from page 85*) used, proper means of aligning them must be devised. The relationships between molding pressure, molding temperature and curing cycle for thermosetting resins should be investigated even more fully to determine the effect of these variables on various strength properties, elongation and moisture-absorption characteristics. Few such data have been published officially for general guidance and the establishment of specifications.

Research in resins must be undertaken to improve the ductility and elongation of thermosetting and semi-thermosetting types. By improving these properties the industrial application of laminates will be greatly expanded by improving the post-forming qualities of the materials and by increasing the joint efficiencies possible in bolted and riveted connections. Specifications should be set up to govern the manufacture, fabrication and processing of structural-type plastics. In addition these structural-type plastics should be clearly distinguished from strictly commercial or electrical types of materials. These specifications should separately cover each of the following:

1. Resins suitable for laminating at contact, low and high pressures.
2. Methods and processes for impregnating fiber-base materials with permissible resin content ranges for various fibers.
3. Molding processes.
4. Forming processes.
5. Fabrication processes.

While past applications of plastics have been largely confined to the electrical or decorative fields, the development of high-strength types having the properties given in Table I opens new fields for synthetic materials. Comparison between aluminum alloy and plastic monocoque-type primary aircraft structures designed for identical use and to the same load factors, definitely indicate that plastic structures can be designed which will meet the weight restrictions and strength requirements. At the same time, appreciable structural simplifications will result. By initially designing aircraft for plasic construction, just as most aircraft now are designed for metal construction, it may be expected that further simplification and weight reduction will be achieved in the future.

Aerodynamic considerations also favor low-density materials. Air-foil contours must be accurately maintained for all normal flight conditions on high-speed airplanes and on helicopter rotor blades which usually operate at high velocities. The low density of plastics permits the use of relatively heavy gages which can be designed to be free of wrinkles at high-load factors. Furthermore, the heavier gages make it easier to recess mechanical attachments when these are required. Bonded joints may be employed to eliminate a majority of the rivets, bolts and screws.

A further advantage of plastic materials is their inherently low heat conductivity which may be used to some advantage by reducing cabin heating requirements in high-altitude airplanes. Recent developments in sandwich construction which has exceptionally good insulating properties, make it possible to provide insulation and structure simultaneously —further increasing simplicity and reducing weight. Aircraft uses of high-strength plastics is but one of many industrial applications envisioned for these materials. Made up into standard structural shapes, they may find widespread application in the framing of homes where the light-weight insulating qualities and ease of erection of wood will be coupled with strength and durability equivalent to steel. Large panels of sandwich-type construction may be used for walls and floors where high rigidity and good insulating properties are desired. Standard items such as doors may also be mass-produced at low cost. The trend toward plastic automobile bodies initiated by Ford may be expected to continue. Lighter automobiles will be necessary in order to reduce fuel consumption and other operating costs.

Weather-resistant molded plastic boats in small sizes are

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a good possibility for high-strength plastics. Home air-conditioning, food freezing units and office furniture are other probable uses. It is likely that the use of plastic materials of all types will be limited only by facilities for producing them, the ingenuity of designers in developing products and the ability of research men to make improvements.

In the past the farm has had relatively little opportunity to contribute to the supply of raw materials furnished to industry. The use of natural fibers in plastics, particularly fibers coming from such annual crops as cotton and flax, may open new outlets for agricultural products, benefiting both farm and industry and bringing them closer together.

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[2] "Toughness of Molding Materials," Thomas Hazen, MODERN PLASTICS *21*, 103–106, 144 (Oct. 1943).

[3] "Aircraft Design Considerations," Haskell R. Gordon, MODERN PLASTICS *21*, 101–110, 148, 150, 152 (Sept. 1943).

[4] "Basic Physical Properties of Laminates," F. B. Fuller, MODERN PLASTICS *20*, 91–102, 126, 128, 130 (Aug. 1943).

[5] "Engineering Aspects of Plastics," Henry Sang, Aero Digest *43*, 163–165 (Aug. 1943).

[6] "Aircraft Applications of Plastics," C. L. Fell, MODERN PLASTICS *20*, 89–90, 128 (July 1943).

[7] "Engineering Properties of Plastics," F. B. Fuller, MODERN PLASTICS *20*, 95–97, 130 (June 1943).

[8] "Plastics Applied to Airplane Structures," C. F. Marschner, Mechnical Engineering *63*, 787–790 (Nov. 1941).

[9] "Structural Considerations Favoring Plastics in Aircraft Structures," C. F. Marschner, MODERN PLASTICS *17*, 41–42, 44, 68, 70 (Sept. 1939).

[10] "Plastics as Structural Materials for Aircraft," G. M. Kline, N.A.C.A. Tech. Note No. *628* (Dec. 1937).

[11] "Synthetic Resins in Aircraft Construction—Their Composition, Properties, Present State of Development and Application to Light Structures," K. Riechers, translated in N.A.C.A. Tech. Memorandum No. *841* (Nov. 1937).

[12] "Plastic Materials for Aircraft Construction," N. A. de Bruyne, J. Royal Aeronautical Society (Jan. 1937).

A self-contained compass

(*Continued from page 89*) from the cavity when the casting is ejected. Parts subject to shrinkage and warping are cooled in air stream cooling fixtures.

Finishing is either by hand or machine operation, whichever is the more economical. All gears are flashed by processing through broaching dies while bowls and discs are flashed by a locating die in kick-press operation. Drilling and tapping is completed on fixtures specially designed for precision and economy. Letters and numerals on all exposed parts are applied by brush, the lacquer baked and surplus removed with a moistened pad in a spinning operation. Filling of numerals and the index line on the compass card which is the floating member, is accomplished by radium process according to Air Corps and Army Ordnance specifications. The general finish of all exposed parts is from acid-edged surfaces. This treatment removes all polish and the possibility of light reflection.

Due to the fact that this instrument must prove accurate to the degree required by U. S. Ordnance Department specifications under all conditions and in every section of the globe, proper tolerances were established in the design of the various parts, especially in the design of the many gears, so as to compensate for expansion and contraction. This insured that the precision necessary in the development of the molds was maintained.

Credits—Material: Resinox, Bakelite, Lucite, Plastacele, Fibestos, Tenite 2, Lumarith and Nitron. Molded by Michigan Molded Plastics, Inc. for Sherrill Research Corp. for U. S. Army Ordnance Department.

A trio of typical airmen

(*Continued from page 102*) modeled to the accuracy of one millimeter on all dimensions that were used as standards for the design of the plastic articulated manikins. After the figures were sculptured in clay they were molded and cast in plaster as a permanent record. Army engineers checked and rechecked the clay models to insure that every measurement was in accordance with those secured in the actual study. From the plaster statues dies were produced to duplicate in plastic every body segment of each of these figures. The construction is clearly evident in Figs. 1 and 2. Each section is a complete molding in itself—assembled by means of $^3/_8$-in. shock absorber cord. The flexibility of the figures, achieved through the use of this cord together with the 17 separate body sections, permits the manikins to be utilized to the best advantage.

While the original purpose of the plastic figures was to aid in mock-ups for designing gun turrets, determining seating requirements, etc., they have taken on additional duties. Now they assist in the designing of flying clothes, oxygen masks and many other types of equipment used by Army Air Forces personnel.

Credits—Material: Fibestos. Molded by General Plastics Corp., for Army Air Forces.

Honorable discharge button

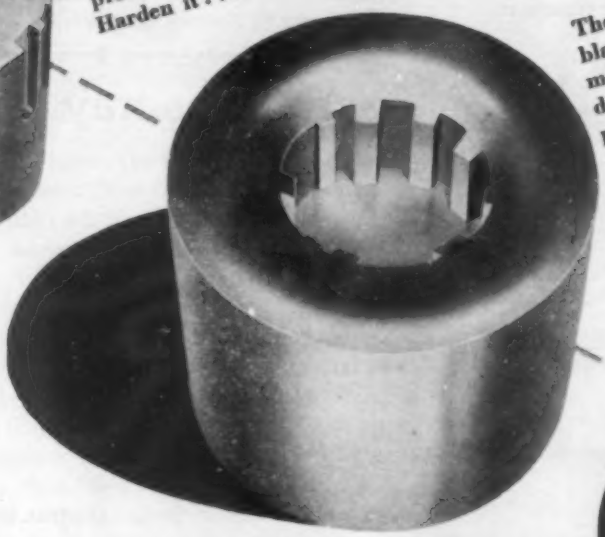
(*Continued from page 80*) attacks acetate. This difficulty was overcome by skillful adjustment of the solution and the current flowing through it so that a sufficient amount of silver was deposited on the conductive-treated buttons before the cyanide was able to attack the plastic. There was some fear concerning the gold plating due to the fact that the gold bath must be maintained at an approximate temperature of 155° F. which is very near to the flow temperature of the acetate. However, it was found that the .003-in. silver plate made possible the immersion of the plastic in a bath of this temperature without deformation.

The Metaplast plating technique is interesting and involved. The plastics are first treated mechanically and chemically to create a conductive surface which will adhere to the plastic base despite considerable pull. The treated buttons are then allowed to dry or are force-dried for a period varying from 2 to 4 hours. After this, they are placed in a barrel plater which is run for approximately $10^1/_2$ hr. until the required thickness of silver plating has been deposited. During the first 15 min. of this process, the buttons must be watched closely to see that the silver is going on evenly and smoothly. A careful check on samples is also necessary at this time to be sure that there is no deforming of the plastic base and that the plate is adhering properly since the plating magnifies all pock marks, sink marks or other defects. After the buttons have received the base .003-in. plate, they are placed in a tumbling barrel. Here, with burnishing solution and steel shot, they are brought to a high finish. This is the only way in which a proper gold "gleam" can be obtained on the finished buttons. In order to expedite production, specifications were changed to allow the use of copper as well as silver as a base plate material.

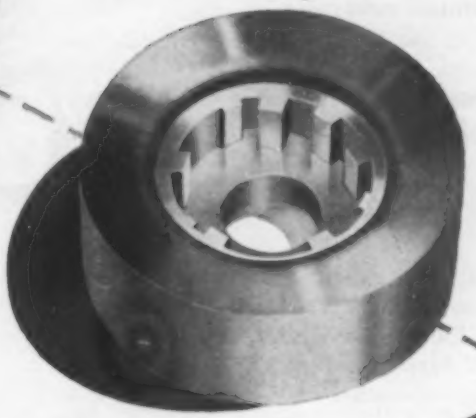
When the buttons have been plated with the copper or silver base, they are placed on racks holding one gross of buttons per rack. Then they are immersed in the gold solution for approximately $2^1/_2$ min. or until they have received the

3 "Simple" Steps IN MAKING A HOBBED CAVITY

First, make the hob, reproducing in steel the exact contours of the piece to be molded. Harden it . . .



Then press this hob into the blank of prepared steel. Enormous pressure is required to do this, and two or three pressings alternated with annealing may be necessary.



Machine away the surplus metal and harden. One or any number of identical cavities can thus be produced.

WE'RE GIVING AWAY NO SECRETS . . .

in explaining and illustrating the method of hobbing a cavity. It must be clear that this process has many advantages—frequently it is the only practical way a cavity could be produced. We won't deny, though, that this is a branch of mold making in which experience, knowledge, skill and equipment play important parts.

Possibly because Midland Die and Engraving Company is unusually well fitted for it, hobbing cavities has become a specialty here. At any rate, we have been particularly successful with many intricate assignments and invite you to consult with us on your present or future mold or die problems.

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necessary amount of gold. This, too, is a critical stage of the process and one which involves considerable expense. Since about 16 cents worth of gold is deposited on every dozen buttons, it is obvious that if the buttons are left in the solution too long, the total cost, spread over a million buttons, will amount to a considerable sum of money. For this reason highly skilled and trained workers are needed to perform such operations on a production basis.

The process of carding the buttons was speeded by changing the design of the hole cut in the cards to facilitate rapid handling. As a result of increased efficiency brought about by special time studies, output jumped from an average of 18,000 a day, as called for in the contract, to a production peak of 50,000 buttons plated, packed and shipped daily.

The finished button is not only extremely attractive but also long-wearing. It is an excellent example of the fact that plastics and metals can be complementary rather than competitive.

Credits—Material: Fibestos and Lumarith. Molded by Commonwealth Plastics Co., Standard Plastics Co. and Rex Products Co. Plated by Monroe Auto Equipment Co.

High frequency

(Continued from page 109)

In previous studies of high-frequency heating which have appeared in MODERN PLASTICS[1, 2, 3] the following additional advantages of this method of preheating have been reported:

1. Great reduction in curing time.
2. Decreased stresses on the mold parts.
3. Lower acetone extractables even with drastically reduced curing times.
4. Great reduction in necessary molding pressures which makes possible the use of smaller, lighter and cheaper press equipment as well as of much lighter molds
5. Elimination of internal stresses which have previously caused warping and cracking.
6. Possibility of using molding compounds which are less expensive because of their lowered resin content.
7. Possibility of compression molding of very thick sections which previously has not been economical.
8. Permits the filling out of deep, thin sections due to the ease with which the material flows.

The above advantages can be classified as basic. From these stem many individual cases of specific advantages peculiar only to a particular job. It is common knowledge that there are many molding jobs which at present are either not satisfactory or have been classified as failures. Many of these jobs can be satisfactorily molded if aided with high frequency heat. For this reason the Engineering Section of MODERN PLASTICS will continue to report on different molding jobs which have successfully made use of this heat.

Credits—Material: Bakelite. Molded by Molding Corporation of America for % Proportioneers, Inc.%.

[1] "Molding with Radio Frequency" by W. M. Witty, MODERN PLASTICS *20*, 83–5, 132–3 (May 1943).
[2] "New Application of Heatronic Molding," MODERN PLASTICS *21*, 106, 7 (Nov. 1943).
[3] "Fire-Fighting Horn," MODERN PLASTICS *21*, 116–118, 170–172 (Jan. 1944).

6—Upon removal from between the electrodes, the material is not hard and granular but soft and mushy

Army mess tray

(Continued from page 91) conducted by pouring boiling water into compartments until they are half filled and then placing a plate glass cover over the compartments for a period of 5 minutes. The presence or absence of odor is determined immediately after removal of the cover.

To find the tray's resistance to boiling water, it is immersed in boiling distilled water for 30 min., and then allowed to stand for one hour at room temperature. This cycle is completed four times. The tray is then allowed to stand for 48 hr. in air at 77° F. with a relative humidity of +50 or −5 percent. During this time the tray is supported along its short edges, with the long axis at a 45° angle to the horizontal, face down. At the end of the test the tray is examined for cracks, surface chalking or warping.

The water absorption test is conducted by drying a $1\frac{1}{2} \times 3$-in. specimen cut from a tray, in an oven at 50° C. for 24 hr., cooling in a desiccator and weighing. The conditioned piece is then suspended 24 hr. in a boiling 5 percent soap solution, and afterward rinsed, wiped and weighed. The percentage of weight gain is determined by the usual water absorption calculation and must not be more than 2.5 percent.

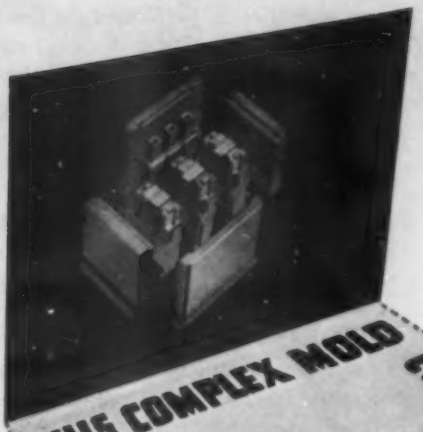
The information and experience obtained from this practical and critical use of melamine-formaldehyde plastics will suggest many new uses and applications for this material.

Credits—Material: Melmac. Molded by Eclipse Moulded Products Co. for U. S. Army Medical Corps.

Polystyrene insulator

(Continued from page 114) two V-blocks and resting on the supporting guide. The motor then is started. When it comes up to speed the saw is carefully lowered into position until the housing rests on the supporting guide. With a maximum of care the tubing next is fed into the saw until it has been slotted over its entire length. Upon the completion of this first longitudinal slotting operation, the motor again is raised and the tubing rotated through the required angle. When the tube again is located into position, the saw is lowered and the operation repeated. After the tubes have been cut in two positions the sections are removed. These 90-, 180- or 270°-segments then are sawed into $\frac{1}{2}$-in. lengths—thereby completing the insulator segments.

The thought and effort which went into the production of



OUT OF THIS COMPLEX MOLD COMES THIS

Plastic Masterpiece

Examine carefully this complicated circuit breaker housing. The design embodies twenty bolt holes, six of them recessed to secure hexagonal nuts . . . all produced in the molding and a simple counter-boring operation. Notice how the top, walls and dividers are intricately formed to fit the shape of electrical members which it will hold. Consider what plastics contributes to this product in the way of strength, electrical characteristics . . . yes, and eye-appeal! Then stop to think how much this piece would cost . . . in materials, man-hours and money . . . if it had to be fabricated by any means other than plastic molding. Here is a plastic masterpiece indeed! We of the MOLDED PRODUCTS organization feel a pardonable pride in the complete production of both mold and molded part. Perhaps your product could employ a similar housing . . . or merely a simple molded knob. No matter what your problem, we would be glad to have our engineers consult with you or to submit quotations based on your specifications. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago 24, Illinois.

PLASTICS DIVISION

MOLDED MP PRODUCTS

these insulators may not appear at first glance to be of any great importance. However many a molder would have taken this job, designed and built molds, and produced these parts by injection molding. The fact that the customer now has requested that the length of the insulators be increased in the future, further emphasizes the foresight of this extruder. As a matter of fact, two different lengths are going to be required: 1/8-in. and 3/4-in. If injection molds had been built, the cavities and plugs would have been made valueless by this change in specifications and, very possibly, the plates themselves would have had to be scrapped. However, in this case, the only change that will be necessary is a slight alteration in the cut-off setting of the saw so that the insulators will be cut to slightly different lengths.

Credits—Material: Lustron. Extruded and fabricated by Sandee Manufacturing Co. for U. S. Navy

Speak and be heard

(*Continued from page 75*) ance record possible includes a plastic cord grip for electric cable, and plastic bearing and moisture seal for operating control.

As can be noted in Fig. 3, the operating plunger has a close clearance fit into the handle, which keeps moisture, mud and sand from interfering with switching action. The molded-in recess in the plunger makes its use by heavily gloved hands positive and convenient, and the unique and simple plastic-mounted plunger return-spring gives very positive control with only a light holding pressure The mouthpiece of this unit incorporates a close-tolerance acoustic cavity. In addition it is, simultaneously, the mount for the microphone button and a noise shield for excellent signal to noise ratio in microphone output. The deep recess provides lip clearance so that without special instruction various personnel can obtain almost identical results. This Navy Standard T-38 Specification microphone with its all-plastic housing, improved response and remarkably repeatable performance has superseded earlier types. Rejections of plastic materials used in this instrument have amounted to but a few percent in spite of the close fits and the strict requirements for dimensional stability. This would seem to show that engineering, carefully applied and accommodating reasonable variations in plastic parts, can accomplish unusual results with good molds and their careful operation.

Recently the desirable qualities of this microphone have been incorporated in a new lip-type microphone (Fig. 1) of considerably reduced size in which even closer tolerances have been held. Remodeling of original molds to provide gas release, and careful alignment of components of the various cavities have made possible highly uniform plastic components which reduce production time and maintain great uniformity in the finished product.

The plunger of the hand microphone is produced in a 6-cavity, single-filling-weight mold with ejector pins in the bottom. Some trouble was encountered in the original mold due to the fact that, because of the lack of a taper on the piece, the parts had a tendency to mushroom or become misshapen.

The microphone handle is molded in a 4-cavity semi-automatic mold with the side pins mounted on a drawbar. Here again, accuracy of dimension dictated the type of mold and method of operation. Pills, or preforms, are used in molding this part. The mouthpiece of this piece of equipment is also produced in a 4-cavity mold in which preforms are used. In order to insure a proper fit between the mouthpiece and the handle, a turning operation is performed on the piece after molding. This work is done with a diamond cutter which eliminates any out-of-roundness that might develop.

Both parts of the lip microphone are transfer molded in 2-cavity dies. In order to maintain accuracy of dimensions, it was determined that transfer molds were absolutely necessary and that the tools had to be limited to 2 cavities. The positioning of the angular side hole in the cover, so that it is always in a particular position on the case when completely threaded, is obtained by keying the threaded plugs in both molds. It was absolutely essential that this be done so that the lead wire which passes through the hole in the cap will be in the proper position when the microphone is in use. Both molds have been sand-blasted so that the instrument will not have reflective highlights while in use.

Switches

Another development is a switch control (Fig. 8) for sequence-switching of radio relay and microphone, and for many other uses where a multiple position hand-switching of simple and infallible construction is required. This plastic-housed unit, which is about the size of a pistol grip and equally durable, includes in the two component parts many features of simplicity. As can be seen in Fig. 8, the body of the switch incorporated a cord-protecting ferrule, a serrated cord grip which holds the communicating cable, four electric contact springs, an operating plunger with accurately aligned bearings, an independent operating handle and a reset spring assembly. Opposite the cordage is a recess for the separable connector plug which is polarized and provided with three circuit contacts.

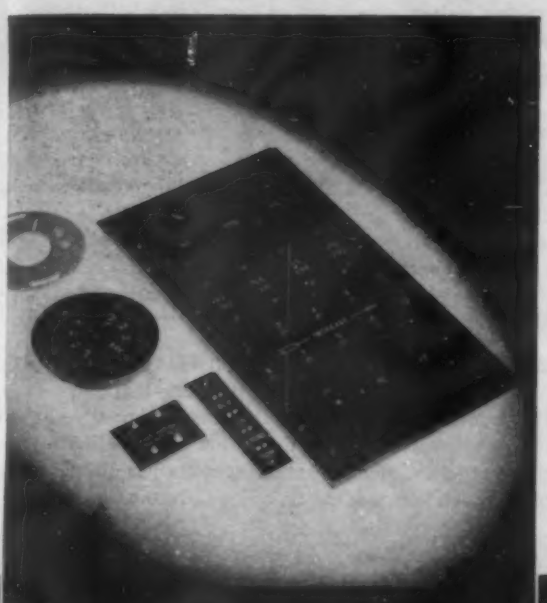
The switch operates as the control member for head telephones and lip microphones in such a manner that interphone connection is established in the half-way position of the lever and radio communication in the fully depressed position. The hand lever operates from a fulcrum molded into both halves of the handle and provides for reliable independent operation of either circuit no matter how the switch is grasped in the hand. No slur from one circuit to the other is possible because of the unique reset spring structure. In addition the holding of the contact is not tiring even for long periods of service. The accomplishment of this action in a positive manner depends on the uniformity of the molded parts in respect to size, freedom from abnormal warping and strength of the high-impact material used. Spring pressures and operating characteristics are retained over periods of years and hundreds of thousands of operations.

The switch housing is produced from a 4-cavity, semi-automatic mold containing two impressions of each half of the case. The mold is steam-cored and the cavities are sand-blasted to give the molded parts a dull matte finish. Shrinkage of material is carefully controlled in order to insure that each half mates properly with the other. Grooves on outside insure good grip by gloved hands, save material and reduce weight.

Conclusion

Such gratifying results have come from the use of plastics in places in our equipment where other materials have been the accepted practice despite the fact that some of them are much more difficult to fabricate and to use that we believe our new designs will make still greater use of plastic materials now on the market and new ones soon to be released. Our results have not been due to engineering alone or to machining and assembly, but have included the considered handling

"H HOUR" ON "D DAY" STRIKES—



In instruments of communications of every description, parts of National Vulcanized Fibre and Phenolite, laminated Bakelite, have extensive and varied use. These possess great dielectric strength, lightness in weight and exceptional wearing qualities.

THE attack is on! The army's ears are working full blast! All the circuits are open! From the C.O. to the Ranger's Walkie Talkies, to the plane support, to the tanks, to the artillery, to all the combat teams, back and forth, a surge of communications fills the air. The very success of the advance depends greatly upon countless instruments of communications. Vital in turn, to their flawless performance, are plastics like National Vulcanized Fibre and Phenolite, laminated Bakelite.

We salute the electronic engineers of America who have given to our fighting men at the front the very best in communications.

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WILMINGTON DELAWARE

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Signal Corps U.S. Army Photo.

of the job all the way from research through design to the mold maker, molder and manufacturer.

Our difficulties have been the result largely, of an improper, initial, judgment of the material, the variation between cavities of a mold, and shortcomings in the mold design, particularly as regards uniformity of sizes in various cavities, choice of mold type and improper handling of the mold in production. We have learned the hard way that what appeared to be minor surface defects, a result of bumps or nicks in the molds, were terribly expensive in the interference they caused on the production line; that a well-designed mold carefully machined and carefully used in production made the manufacture of these precise instruments a real pleasure—lowering cost and inspiring the new designs that will make still greater strides toward perfection. We have given our molders many headaches and have received much cooperation on our very fussy jobs. The result has been good, and the way is paved for a more efficient and practical handling of our new problems.

Credits—Material: Bakelite. Molded by Boonton Molding Co. for Aviometer Corp. for U. S. Navy

Speeches of the month

(Continued from page 158)

★ HIGH FREQUENCY HEATING WILL PLAY A MAJOR part in fashioning a postwar plastic and plywood world of cheaper, stronger and more uniform products, according to Milton P. Vore, section engineer of the Radio Div., Westinghouse Electric and Manufacturing Co., speaking before a recent meeting of the Connecticut and Springfield Sections of the American Institute of Electrical Engineers at Hartford, Conn. At present it is making an outstanding contribution to the war effort in the reflowing of tin. Plywood has many advantages over natural lumber in that it is uniform in quality throughout a given piece, is lighter and stronger, and can be fabricated in any desired shape.

★ ISLYN THOMAS OF IDEAL NOVELTY AND TOY CO. and N. G. Levien of Ivorycraft Co., Inc., spoke at a meeting of Plastics Engineers Association on January 17 at the Yale Club. In his address, Mr. Thomas, whose subject was injection molding, traced the origin of this art and proved that it started in the 19th century when the first "stuffer" was put into operation. He then explained many important points on molded part design and mold design. Mr. Levien, an old-timer in the cast phenolic branch of the plastics industry, gave a history of its origin.

★ EGMONT ARENS, INDUSTRIAL DESIGNER, SPEAKing before a meeting of the Plastics Club of the United States, gave a picture of how industrial designers and engineers in the plastics industry must work together to combine proper color, balance and eye-appeal for the consumer market. Designers must be constantly aware of "color fatigue" and the influence of the theatre, of movie sets and fashion upon people's color preferences. According to Mr. Arens, esthetic design, "human-eering" and the "feel" of public demand are all embodied in sound industrial designing.

Books and booklets

(Continued from page 150)

★ "COTTON TEXTILES FOR PLASTIC LAMINATES" is the title of a booklet brought out by the Cotton-Textile Institute, Inc., New York, N. Y. It is the first of a series undertaken by the Institute with the object of pointing out to the industry the possibilities for new business presented by industries that have grown tremendously since Pearl Harbor. Concerned primarily with plastic laminates, the brochure presents recent developments and their bearing on future consumption. There are sections on various types of laminates and fillers, and one particularly interesting unit on opportunities for research. Illustrations and a list of manufacturers of laminated plastics add to the interest of the book.

★ "FACTS ABOUT PLASTICS," A 24-PAGE, NON-TECHnical booklet just released by The Richardson Co., Melrose Park, Ill., covers all types of plastics and their uses, and presents general information about the plastics industry. The possibilities of present and postwar uses of Insurok and other plastics are discussed, and the limitations of plastics are not left unnoted. This book is designed primarily for the non-technical man who is desirous of obtaining a general knowledge of plastics and their applications. Excellent illustrations add greatly to its clarity.

★ A SECOND, BASIC INFORMATION BOOKLET ON Coated Abrasives has been published by Behr-Manning, Troy, N. Y. It is a revised edition of Booklet No. 1, originally put out for distributor salesmen, and is a discussion of coated abrasives, their component parts, their manufacture and their ultimate use, with information on how to identify, order and store sandpaper.

★ STANDARD MOLDING CORP., DAYTON, OHIO, HAS released a booklet on molding which reaches beyond the limits of the products they produce to include in comprehensive detail the essential differences between injection and other types of plastic molding. The word thermoplastics is defined and materials included in that group are listed. Applications of injection-molded thermoplastics are also discussed. Injection-molded machines are shown, and many illustrations of specific products made by this company make the books more interesting.

★ CLEVELAND TAPPING MACHINE CO. HAS ISSUED A 12-page booket which is called "A Guide for Production Tapping." Various useful data, relating to automatic tapping as performed on lead screw tapping machines, are listed in its pages. Alloys of steel, suggested tapping speeds, suitable lubricants for all materials, spindle speeds, number of pieces possible per hour on production runs and basic thread dimensions and tap drill sizes are all discussed, and many charts and tables make the text more readily understood.

★ THE ARMY-NAVY CIVIL COMMITTEE ON AIRcraft has just issued a bulletin called "Plastics for Aircraft," compiled under the supervision of the Aeronautical Board. This booklet has been prepared to aid in the design of both commercial and military aircraft and contains material acceptable by the Army Air Forces, the Bureau of Aeronautics and the Civil Aeronautics Administration. Copies may be obtained from the Government Printing Office, Washington, D. C., for 40 cents.

★ "SETTLING PLANT GRIEVANCES" IS THE SUBJECT of a short, but extremely informative booklet prepared by A. M. Ramsay and M. B. Dahl, Division of Labor Standards, U. S. Department of Labor. The pamphlet offers a review of grievance procedure under collective bargaining and reports ways in which labor and management have learned to carry out this procedure effectively. An appendix contains a complete text of sample union agreement clauses providing grievance procedure and arbitration. Employers or others desiring to procure copies for reference may obtain them by writing to the Division of Labor Standards, U. S. Dept. of Labor, Washington 25, D. C.

★ CHEMICAL ENGINEERING CATALOG FOR 1943–44, published by Reinhold Publishing Corp., is a collection of condensed, standardized data on equipment and materials used by the industries employing chemical processes of manufacture. More than 2500 books have been briefly described in the bibliographical section and many more are cited by author and title. Alphabetical indexes of the firms represented and of trade names are incorporated in this catalog as well as classified indexes of equipment and chemicals.

THE USE OF LUMINESCENT PIGMENTS —NOW AND TOMORROW

LUMINESCENT PIGMENTS—both the Fluorescent and Phosphorescent types—are manufactured and used on a tonnage scale in a number of essential war applications—luminescent dials, computers, charts, instrument identification plates on combat planes; and luminescent tape directional and identification markers on shipboard and in the field.

Because of these war demands, only limited quantities of Luminescent Pigments for civilian use are available right now. That condition, of course, will change as soon as wartime needs have been met fully.

In the meantime, our laboratories are working constantly on new applications for these pigments—in paints, paper, plastics, and inks. New markets are opening up. Why not put this knowledge to use today in developing your products of tomorrow?

FACTS ABOUT LUMINESCENT PIGMENTS

1. Sixteen grades and color types ranging from violet to red have been developed.

2. These pigments are activated by a near ultraviolet (*so-called "black"*) light, or a short wavelength visible light.

3. They contain no radium or radioactive salts.

4. They **no longer** cost $30.00, $10.00 or even $8.00 a pound, the pre-war price range.

5. These pigments are available in quantity at prices from 90¢ to $2.50 per pound.

6. They are stable enough to be used out-of-doors.

7. Luminescent Pigments are used in:

Paints & Lacquers	**Coated Textiles**
Plastics	**Printed Textiles**
Coated Paper	**Decalcomanias**
Filled Paper	**Printing Inks**

8. Fluorescent Pigments are fine in particle size, and may be ground exactly as conventional pigments. They are activated only by "black" light, which equipment has been developed in a wide range of styles and prices.

9. Phosphorescent Pigments may be activated by any light source when used only for their afterglow properties. While coarser than fluorescent pigments, they are fine enough to be incorporated into plastics and paint.

10. The afterglow of the Phosphorescent Pigments varies with each pigment, the intensity of the activating light, and the length of activation, ranging from a few minutes duration to ten or twelve hours, and longer.

"*The ABC of LUMINESCENCE,*" a new booklet, is ready to go to press. It tells the story of Luminescent Pigments—Properties, Advantages, Applications—in simple, easy-to-understand language, and is profusely illustrated. It will be mailed upon request as soon as available.

SEND FOR YOUR COPY of this new booklet.
No obligation, of course!

New Jersey Zinc

Development Products Division

THE NEW JERSEY ZINC COMPANY

160 Front Street, New York 7, New York

Chicago — Boston — Cleveland — San Francisco

News of the industry

(Continued from page 158)

★ PLASTIC MOLD AND DIE CO., PARMA, MICH., HAS recently been organized to specialize in the engineering, designing and manufacture of plastic molds and dies. Partners in the new company are A. D. Lyons, formerly with the Plastics Div. of Reynolds Spring Co., who will be in charge of production; Walter L. Yeager, also of the Plastics Div., Reynolds Spring Co., for engineering and designing; and Berry N. Beaman, manufacturer, as office manager.

★ ERICH MARX, FORMERLY WITH UNIVERSAL Plastics Corp., New Brunswick, N. J., as Sales Engineer and Sales Manager, and for 4 years in complete charge of the American Molding Co., San Francisco, Calif., is now located at 440 34th Ave., San Francisco. In addition to serving as a consulting engineer, specializing in plastics and plastic molding, Mr. Marx will also give a course on plastics at the University of California.

★ THE MODERN PLASTICS EXHIBIT ENJOYED A very successful run at the Halle Bros. Co., Cleveland, Ohio, from January 17 to January 29. The showing was divided into 3 sections: plastics in the home, in industry and in the war effort. From Cleveland the exhibit traveled to New Haven, Conn.

★ THE NAME OF THE PLASTITOOL ENGINEERING Co., Los Angeles, Calif., has been changed to Stack Plastics Co. The company will now be located at 5835 W. Washington Blvd., Culver City, Calif.

★ JAS. H. SAVAGE, WHO RECENTLY RESIGNED AS plastics consultant to Conservation Division of WPB, will be located on the 18th floor of 113 West 42nd St., New York, N. Y.

★ SCIENTIFIC AND TECHNICAL JOURNALS ARE being collected by a committee of American Library Association for shipment to foreign libraries and institutions that are unable to get these periodicals because of the war. We regret that we do not have on hand a stock of MODERN PLASTICS magazines for the past few years. It is only through your gifts that these much-desired copies can be obtained. If you wish to help by donating your periodicals, please write to Dorothy J. Comins, executive assistant, Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D. C.

★ NORTH AMERICAN PHILIPS CO., INC., DOBBS Ferry, N. Y., has purchased all fixed and tangible assets of its affiliate, Philips Metalix Corp., including grounds and factory at 896 South Columbus Ave., Mount Vernon, N. Y., machinery, equipment, raw materials, tools and manufactured products. The business will continue as the Metalix Div. of North American Philips Co., Inc.

★ CORROSION CONTROL CORP., NORWALK, CONN. will be known henceforward as Cordo Chemical Corp. This change is a natural outcome of the expansion of the company's manufacturing program to include industrial finishes, lacquers and bonding adhesives in addition to the plastic corrosion-resistant coating which inspired its original name.

★ JOSEPH P. DAVIS, PRESIDENT, HAS ANNOUNCED that the name of his firm has been changed from The Insel Co. to Joseph Davis Plastics Co. Located in Arlington, N. J., the company now is largely occupied in turning out plastics and plastic parts for the war effort.

★ DR. ROBERT A. HARDIN, CHAIRMAN OF THE INdustrial education department of the University of Oklahoma, has developed a new plastic of high tensile strength and resistance to moisture, after 18 mo. of experimentation. Waste sawdust and shavings may be used successfully to make this opaque synthetic, which has a tensile strength of 9000 p.s.i. and is said to be non-inflammable and highly resistant to the action of acids.

★ ROBERT H. CLARK CO., LOS ANGELES, CALIF., announces the completion of a new plant at 9330 Santa Monica Blvd., Beverly Hills, Calif., which will provide greatly improved facilities for the production of cutting tools for war industries specializing in metal and plastics fabrication.

Cooling water costs

(Continued from page 113) water determines the number of Btu that can be removed per degree temperature difference between the unit and the water. The surface area in contact with the water is equal, of course, to the perimeter of the cooling channel multiplied by its length. Therefore the same surface area can be attained by using either a large size channel of short length or a small size channel of commensurately longer length. Too large a channel is inefficient in that the water in the center of the channel does not have time to heat up because of the insulating effect of the water surrounding it. Similarly, too small a channel is inefficient because the water becomes fully heated before it reaches the end of the channel thereby making the latter part of the channel ineffectual. Other factors which should be given consideration in designing and laying out the cooling channels, particularly in the case of molds, are proper distribution of the channels to insure elimination of local hot spots, and proper routing of the water through the channels to insure that the outlet side of the mold does not run appreciably hotter than the inlet side. A detailed discussion of the solution of these problems is beyond the scope of this paper since it would entail presentation of a large amount of data on heat-transfer engineering as well as a large number of suggested design sketches covering the practical limitations encountered in mold and cooler design due to variations in size and shape, as well as in the type of equipment used.

Generally speaking, the molds and other cooling units in injection presses should be designed to provide more than adequate cooling since it is a simple matter to restrict the water flow if the units are running too cold, whereas it frequently entails either a large amount of tool work or complete replacement of the unit if it is running too hot. In the case of molds, the provision of additional cooling channels does increase their cost. However, this increment of cost can generally earn a profit through the additional water savings made during its productive life.

When setting up new presses, or when re-piping old ones it might be well to consider provision for thermometers at the temperature-reading points listed earlier in the article. Such provision can either take the form of providing thermometer well elbows at these points, so that thermometers can be installed when desired, or of permanently installing thermometers at these locations. If permanent thermometers are installed, they should be of a high-grade precision type, so that the readings can be relied upon over a period of time, and even then they should be removed and checked when there is the slightest doubt as to their accuracy. The entire control of water cost depends on accurate temperature readings, and for this reason only high-grade thermometers should be used. Faulty temperature readings may well nullify efforts at water cost reduction by either indicating falsely high efficiency, or by initiating temperature changes which adversely affect production. On the other hand, accurate temperatures will not only effect substantial water cost savings, but will also provide a closer production control over the quality of the product, as operating temperatures can then be included in the specifications.

a plastic salute

The contributions of plastic science and enterprise to victory in the field is one of the miracles of war production. In the specialized field of plastic fabrication **"dura"** has been privileged to serve America's marine, aircraft and electronic industries, as our part of the war effort. During the past year our production has increased more than 400%. We offer this salute to our employees who stand ready to serve the war front in the future as in the past.

The cooperative spirit of our organization has never failed in meeting the demands for more and more production in defense of our American freedom. This spirit is reflected in bond purchases during the 4th War Loan drive, totalling 28% of our gross payroll.

dura plastics inc.

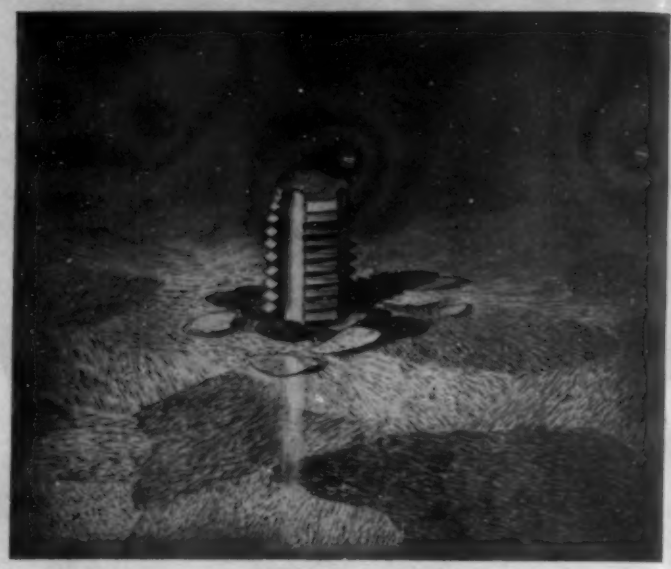
1 west 34th st. new york 1, n. y.

Fabricators of transparent and engraved plastics for the aviation, electronic and shipbuilding trades

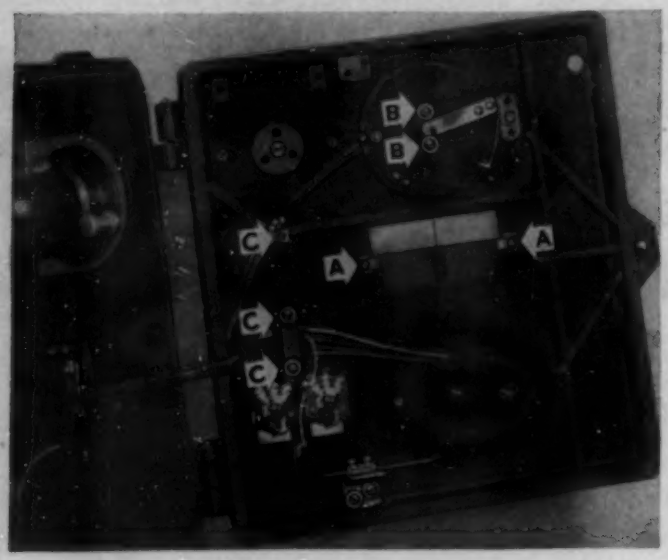
"Blind Fastenings" Boost Parts Breakage

— until Instrument maker adopts the *Simpler* Fastening Method

Changing over to Parker-Kalon Self-tapping Screws is an assembly improvement made in peacetime that paid off in war production for the Tagliabue Mfg. Co., of Brooklyn, N. Y. Their TAG pressure and temperature instruments are in urgent demand by the Air Corps, arsenals, and war plants, and every short cut to greater output is more important today than ever.



DIFFICULTY in judging hole depth, when workers had to tap blind holes for small machine screws, resulted in taps breaking through, ruining plastic parts. Changeover to P-K Self-tapping Screws ended this troublesome "blind man's buff", stopped breakage, saved tapping time and tap expense.



DEPENDABLE STRENGTH is another advantage of the simpler P-K fastening method. Above, P-K Type "Z" Screws are used (A) to attach steel clips fastening window to plastic door; (B) to fasten plastic rheostat disc to door; (C) to attach steel clamps holding wire to door. The screws form their own strong threads as they are turned into plain, untapped holes. One easy operation makes a fastening.

Question every fastening – on the drafting board and in production. Ask for a P-K Assembly Engineer to help you check up. Or, mail a description of your assembly for recommendations. Parker-Kalon Corp., 190-200D Varick Street, New York 14, N. Y.

NO SPECIALLY TRAINED WORKERS or special equipment are needed . . . you can change to the P-K Self-tapping Screw method overnight. Experience proves, that in 7 out of 10 cases, one of the various types of Parker-Kalon Self-tapping Screws will simplify metal and plastic fastening jobs – save vital man-hours – speed production – cut costs – reduce rejects – and actually increase fastening strength.

SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY

PARKER-KALON

Quality-Controlled

SELF-TAPPING SCREWS

IF YOU ARE IN A *Tight Spot* . . . TRY NIXON

Remember? Plenty of delicious jam, but mother kept it rationed too. True, most of our materials are closely controlled . . . but try us anyway. If you're in a tight spot, we'll do our very best to help you get what you need.

NIXON *Plastics*

Cellulose Acetate • Cellulose Nitrate • Ethyl Cellulose
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PART OF YOUR PLANNING

Our Folder File fits the standard file drawer.

This handy-reference Folder File serves you as a permanent reminder of our plastics engineering and molding facilities. Enclosures show examples of Functional Design in Plastics which may be of interest in relation to your post-war product development. For a free copy of the Folder File, write to the address below.

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PLASTIC MANUFACTURERS
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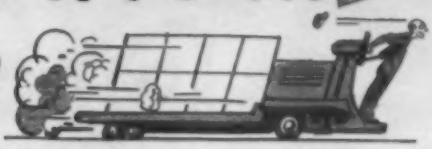
WHAT WAS THAT THAT JUST WENT BY? NOT A FOUR **** GENERAL BUT ANOTHER  LOAD OF WAR EQUIPMENT THAT WAS PUT TOGETHER IN RECORD TIME SINCE ··· THAT FAST-DRIVING RECESSED HEAD SCREW CAME ON THE JOB..... IT'S PHILLIPS···

Sure — the news is swell! But the war isn't over yet. The heat's still on — and production speed is as vital as ever.

One of the surest ways to get more speed in your assembly operations is to put Phillips Recessed Head Screws in the hands of your workers. Hundreds of plants all over the country have standardized on the Phillips screw — and the results have been spectacular. Driving speed has often been doubled. Vital man hours have been saved. Production has been greatly increased — thanks to the Phillips Recess which makes power or spiral driving practical.

Some advantages of Phillips Recessed Head Screws are listed here. Check them against slotted head screws — or any other type you may be using. You'll quickly see why it costs less to use screws with the Phillips Recessed Head.

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS

Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for green hands.

Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

Easier Driving: Turning power is fully utilized. Workers maintain speed without tiring.

Better Fastening: Screws are set-up uniformly tight, without burring or breaking of screw heads. The job is stronger, and the ornamental recess adds to appearance.

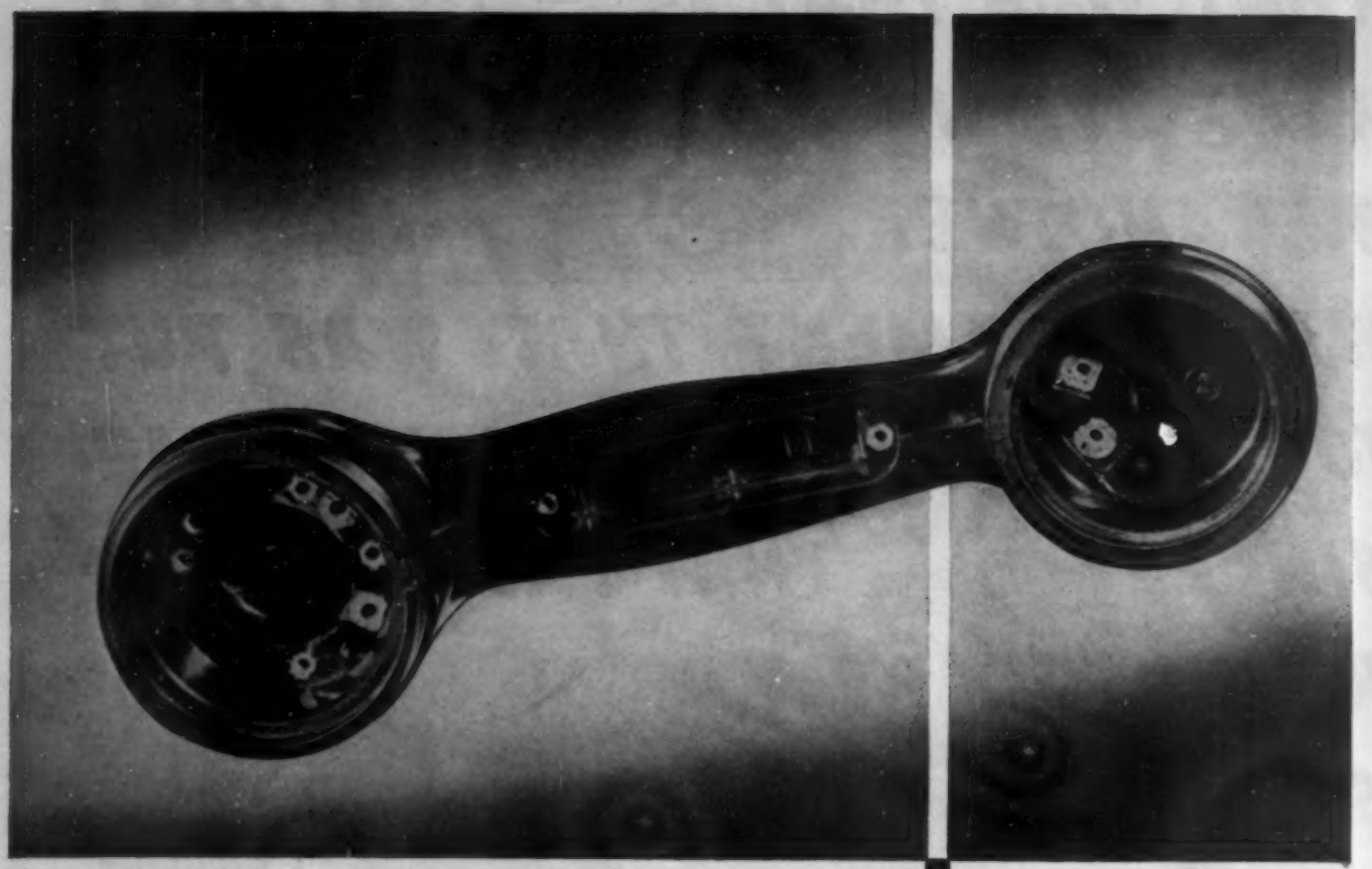
IDENTIFY IT!

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF-TAPPING SCREWS · STOVE BOLTS

23 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.



There is a difference

Looks like the conventional handset of your telephone doesn't it? But if you look a little closer you'll discover that it's different. Handsets like these are molded by Auburn for the Stromberg-Carlson Company and used by the U. S. Army.

And in plastic molding you'll find that Auburn is different too. You'll find that out when you see what Auburn can give to your plastic requirements. You'll find here an organization experienced in every phase of molding all plastic materials, modern equipment, and experienced personnel.

From engineering department to final inspection this organization is set up with one purpose in mind . . . to give you molded plastic parts that are better and more economical. This is just as true whether we are making a molded plastic handset or a thousand miles of extruded tubing.

If you are planning on the use of plastics, get in touch with Auburn. You'll find there is a difference.

ESTABLISHED 1876

AUBURN

AUBURN BUTTON WORKS, INC., AUBURN, NEW YORK

PLASTICS

Services and Products Now Offered at Auburn

Injection Molding

Plastic Tubing

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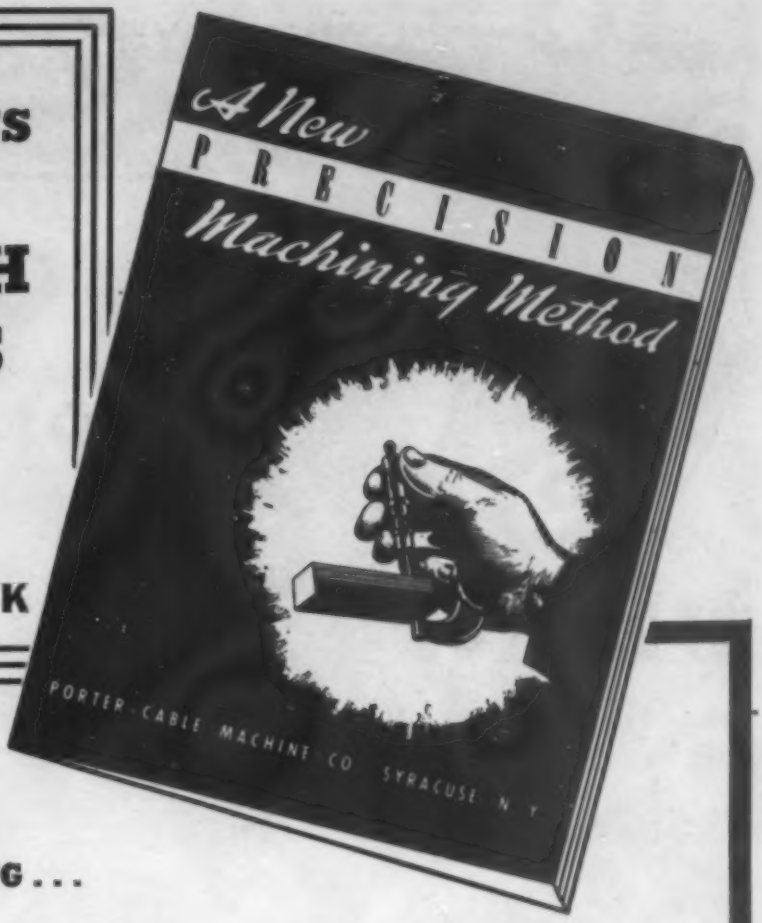
Transfer Molding

Cellulose Nitrate

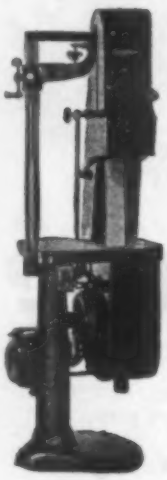
Sheets and Rods

Many New Ways
to get
BETTER FINISH ON PLASTICS
More Efficiently, At Less Cost!

EXPLAINED IN THIS BOOK



- **NO HEAT . . .**
- **NO DUST . . .**
- **NO FLOW . . .**
- **NO DISCOLORING . . .**



Model B-6

By eliminating frictional heat, Porter-Cable's Wet-Belt Surfacing has proven itself the ideal method of finishing plastics and compositions of low fusion point. Wet-Belt Surfacing is amazingly fast—5 to 25 times faster on such operations as removing gates, parting lines and flashings . . . . finishing rough spots . . . . smoothing molded defects . . . . machining true flats on bosses and abutting rims.

The Porter-Cable Model B-6 was especially designed for curved and irregular work, interrupted surfaces and very small pieces. It uses a narrower belt, flexible enough to follow contours and get into places inaccessible to ordinary power tools. You can get a great operational variety by means of platens behind the belt. Or several small pieces can be mounted on a fixture, and finished with one presentation to the belt.

In quantity repeat operations, the Porter-Cable G-8 is reorganizing manufacturing and assembly procedures. Even inexperienced operators can hold parallel, machine true flats, and work within tolerances of .0005"—with a speed that would have seemed incredible but a short while ago.

If you are planning a post-war plastic product, don't fail to consider the many advantages of Wet-Belt Surfacing. Send the coupon for our latest booklet. You are sure to find many uses for the suggestions it contains.

Model G-8

Model G-4 with belt adjustable to horizontal or vertical position. Recommended for small parts.

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Please send me a copy of "A New Precision Machining Method."

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DREAM WORLD

or SOLID BEDROCK *for your* PLASTICS?

The consuming public expects nothing short of miracles from plastics in the post-war era.

Its imagination has placed plastics in a dream world without physical limitations.

This is a dangerous situation — one which every Plastics concern should start to combat *immediately.*

Acquaint the public with both the potentials and physical limitations of your plastic . . . facts obtained by Scientific Testing. Avoid the possibility of your plastic losing favor by falling short of impossible expectations.

Our laboratories are equipped to exhaustively test your plastic and supply the facts with which to anchor your plastic to bedrock.

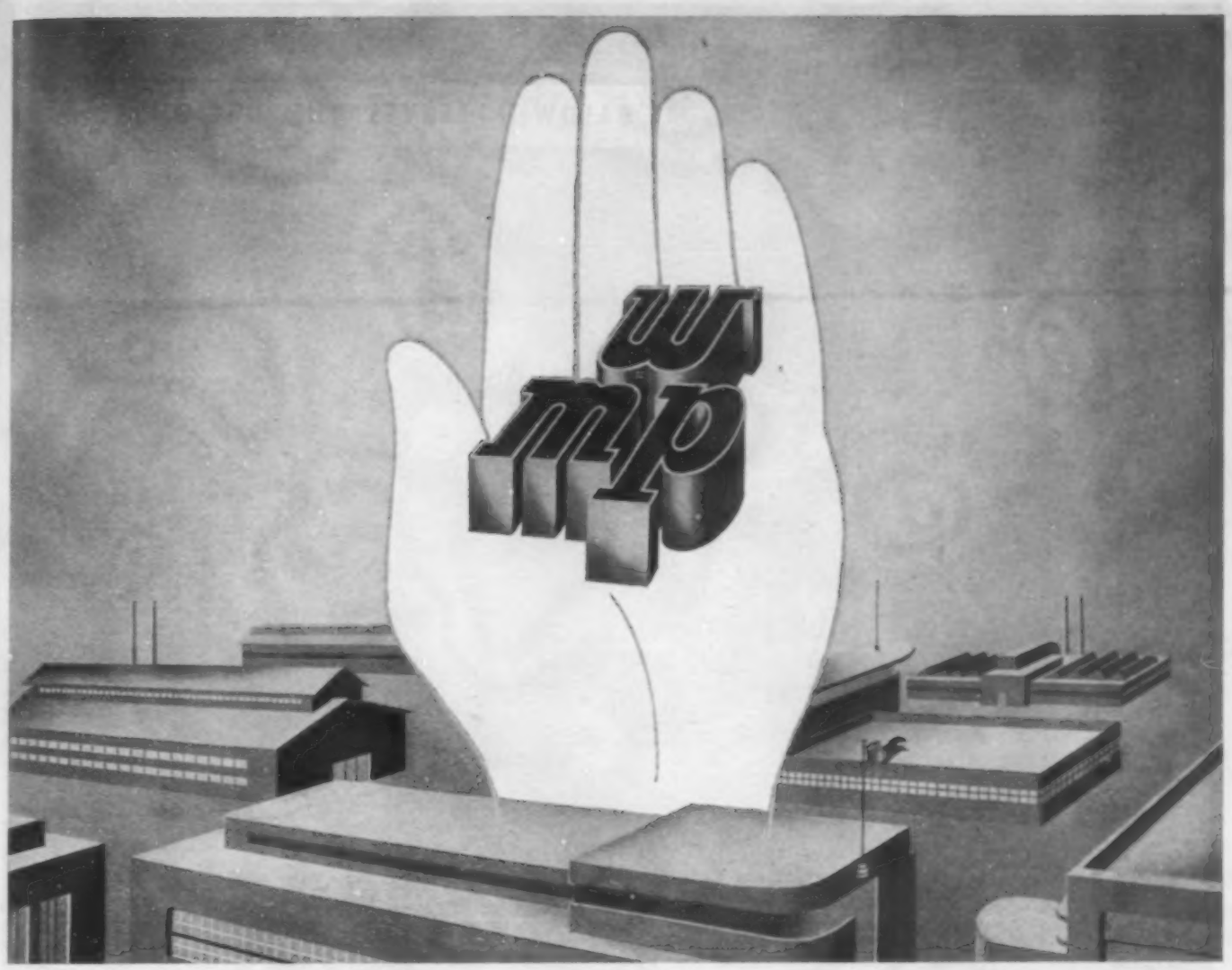
Why not consult our engineers today and let them solve your plastics problems?

UNITED STATES TESTING COMPANY, INC.

ESTABLISHED 1880

HOBOKEN, NEW JERSEY

PHILADELPHIA, PA. GREENSBORO, N. C. WOONSOCKET, R. I. CHICAGO, ILL. NEW YORK, N. Y.



A HAND IN FAVOR . . OF PLASTICS TRUE POSSIBILITIES

One of the best ways to discover the exact value of plastics applied to your product is to choose an experienced source of information. Remember first that we are custom injection moulders. The problems we tackle are as broad as industry, as varied as the finished articles we turn out for customers.

Hearsay about plastic applications is painfully misleading. But custom engineering, backed by precision production of items often reaching into the millions in quantity, warrants your confidence. It is this fact about our organization that has placed a six months star on our Army-Navy E banner, and we hope may lead you to bring your plastics questions to us — FIRST.

For Custom Injection Moulding . . . try the Trio

8 GRAFTON STREET WORCESTER 8, MASSACHUSETTS
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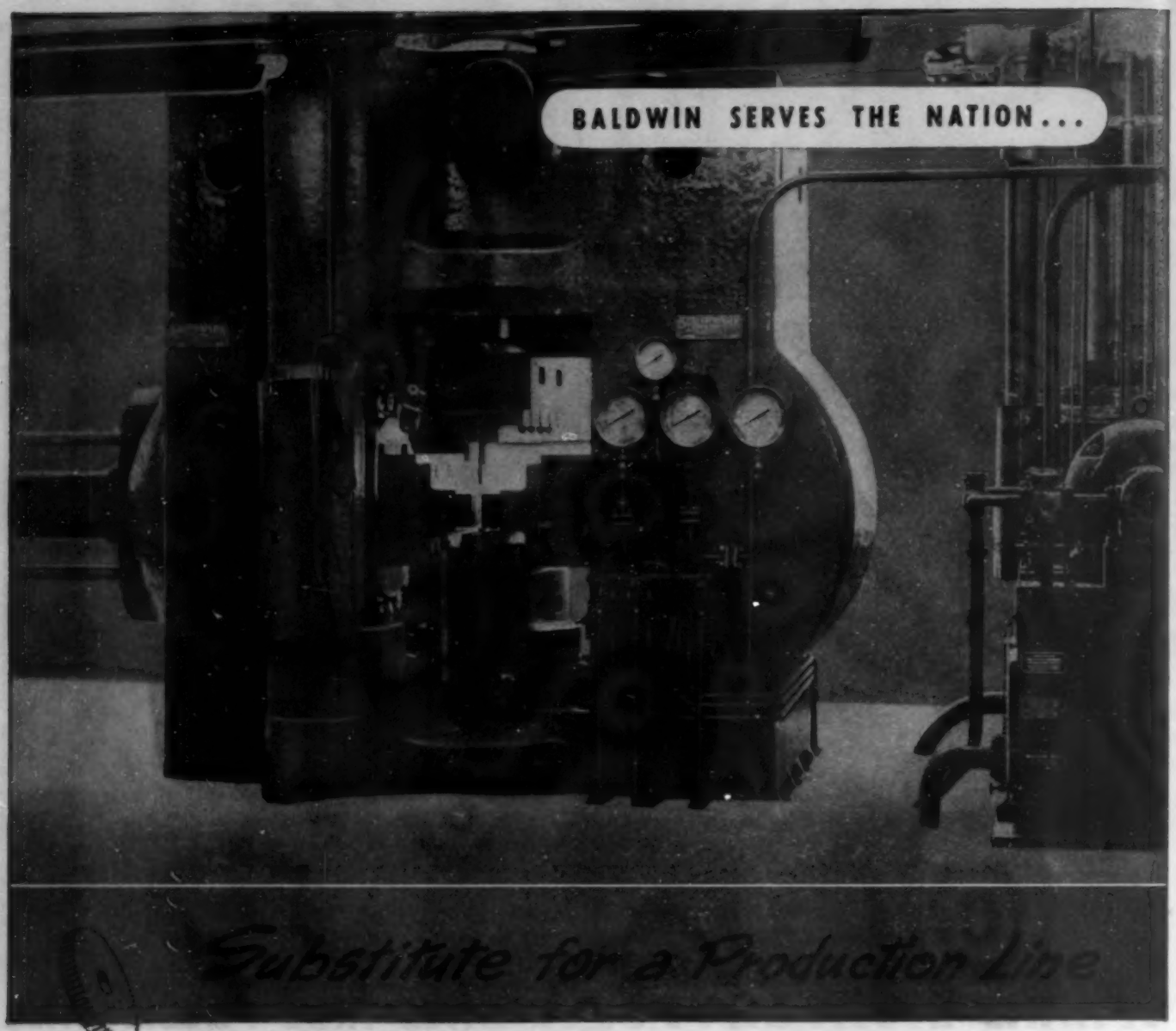

Would you recognize this machine as a combination molder-caster-lathe-drill press and milling or hobbing machine? It is literally handling all of the jobs that all those pieces of equipment do in the ordinary production line . . . and doing it in *one operation*. The material goes in, a handful of powdered metal. It comes out a gear, cam, or other part, ready to install!

Building such a press to mold metal posed a lot of new problems, for instance, uniform density of the molded material was imperative. But Baldwin experience was ready and waiting, and the job was done *right* without time wasting experiment or guesswork.

If your production planning . . . current or post-war . . . contemplates the use of presses, Baldwin experience can help *you*, too. Let us know your problem. Baldwin Southwark Division, The Baldwin Locomotive Works, Philadelphia, Pa., U. S. A. Pacific Coast Representative: The Pelton Water Wheel Co., San Francisco, California. In Canada: United Steel Corp., Toronto.

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Steel forgings and castings
Diesel-electric locomotives
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Metal plate fabrication
Rolled steel rings
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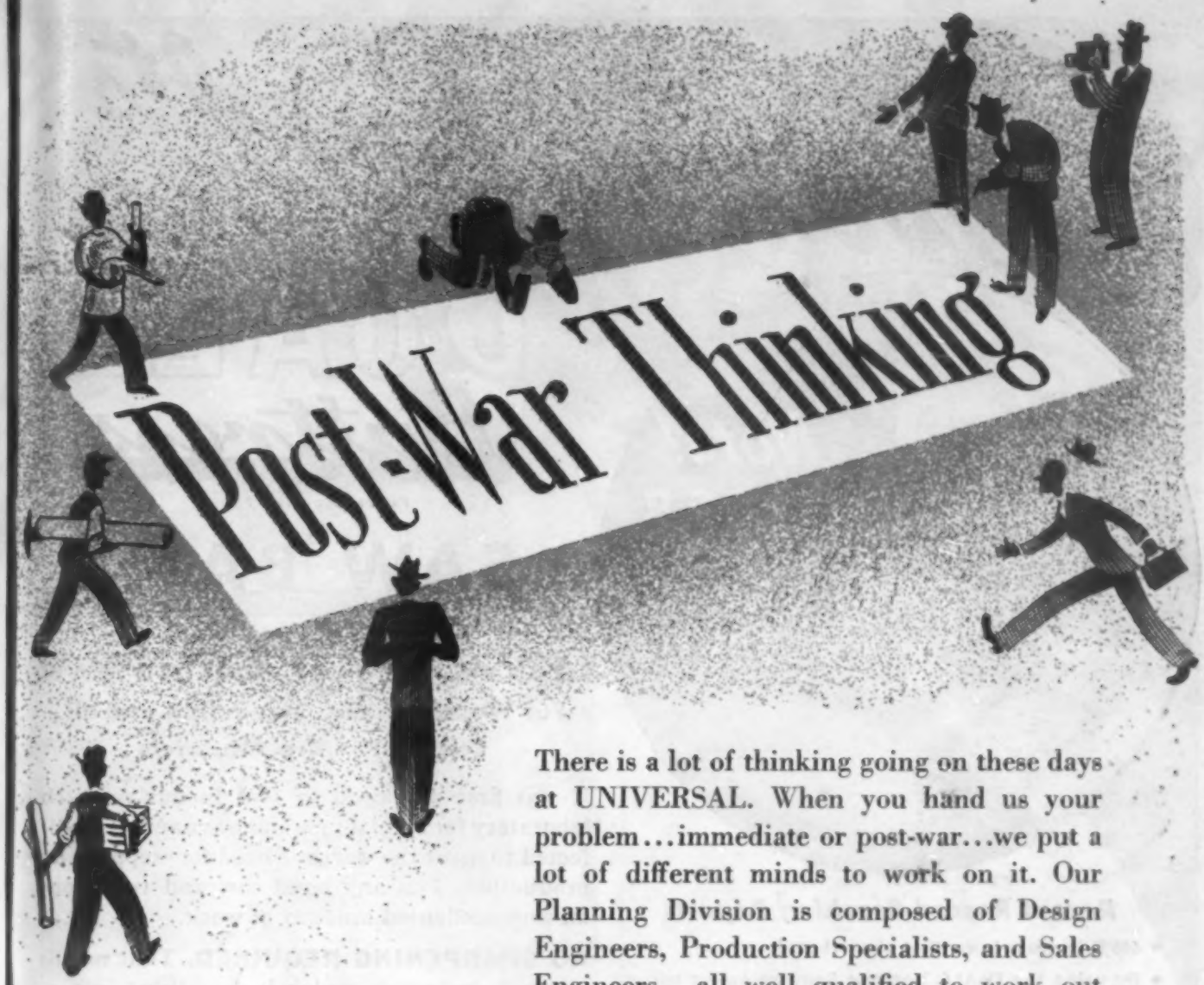
Crane wheels
Bending rolls
Plate planers
Babbitt metal
Alloy iron castings
Briquetting presses

BLW THE BALDWIN GROUP

BALDWIN
SOUTHWARK
HYDRAULIC PRESSES



There is a lot of thinking going on these days at UNIVERSAL. When you hand us your problem...immediate or post-war...we put a lot of different minds to work on it. Our Planning Division is composed of Design Engineers, Production Specialists, and Sales Engineers...all well qualified to work out satisfactorily the preliminary ground work necessary on any plastic application.

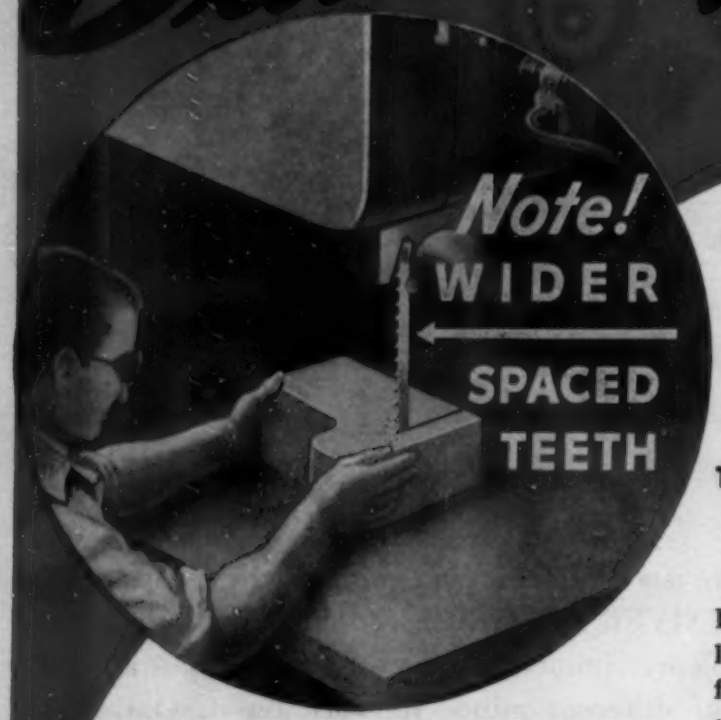
This type of specialized thinking is highly desirable at any time but particularly so just now when manufacturers must solve day-to-day production problems while faced with the need of re-converting their manufacturing set-ups to post-war conditions. Find out more about this UNIVERSAL service. Inquiries are invited.

UNIVERSAL PLASTICS CORPORATION

NEW BRUNSWICK • NEW JERSEY

New York Office: New York 17: 12 East 41st Street
Chicago 3: Steel Mill Products Co., Inc., 176 West Adams Street
Philadelphia 6: Paragon Sales Co., Inc., 402 Cherry Street
Detroit 2: June & Company, 719 New Center Building

Startling Results with the New DoALL Buttress Patent Applied For SAW BAND



Recent Record-Breaking Reports

- 400% increase in cutting plasterboard.
- By using the DoALL Buttress Saw, we expect to eliminate one complete shift. Two shifts will do the work now done by three.
- We now spend 20% of what we used to for blading. 9,500 feet of DoALL Buttress blading does the work of 25,000 to 30,000 feet of blading formerly used.
- Laminated paper bomb rings: 135 square inches cut per minute.
- Wood ripping record with DoALL Buttress Saws:

Birchwood	372.75 square inches per minute
Gumwood	744.50 square inches per minute
Red Oak	621.25 square inches per minute
Yellow Pine	413.75 square inches per minute

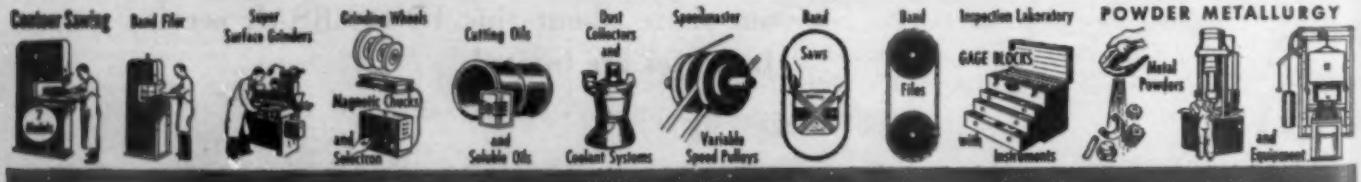
TODAY'S FASTEST CUTTING SAW For Wood, Plastics, Laminated and all Coarse Texture Materials

It was first developed in 1941 in our research laboratory for special jobs and has now been perfected to meet the wartime need for stepping up production. Fits any band saw and turns out an unprecedented amount of work.

NO SHARPENING REQUIRED. That means no work stoppages, which is something important to consider when you're working against time. Use the DoALL Buttress until it's worn out, then just thread in a new saw.

The DoALL Buttress not only does an extraordinary job, but costs no more than an ordinary saw band. Comes in widths up to 1″ and in several pitches.

You'll want to know all about this amazing advance in saws. Consult your local DoALL man.



DoALL

INDUSTRY'S NEW SET OF TOOLS

Write for Literature, mentioning products in which you are interested.
THE DoALL COMPANY, 1205 Thacker St., Des Plaines, Ill.

Sales & Service Offices: Baltimore, Boston, Chicago, Cleveland, Denver, Detroit, Erie, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Orlando, Philadelphia, Pittsburgh, Portland, Rochester, Rockford, St. Louis, Salt Lake City, San Francisco, Seattle, Spokane, Toledo, Tulsa, West Hartford

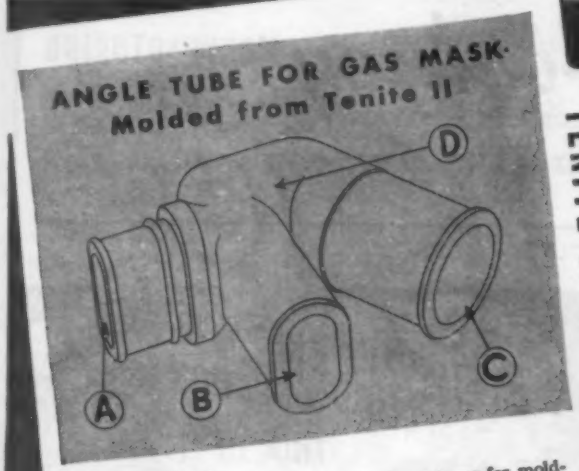
Seventh in a series of plastics applications.

A "New Angle" on Industrial Safety!

THIS *plastic* angle tube is part of a gas mask being used in chemical plants to protect workers against harmful and poisonous gases.

Here again, plastics replaced another material with advantages of lighter weight, lower cost and elimination of finishing operations.

Aico's 28 years' experience in all kinds of plastic molding insures the success of plastics applications with savings of both time and money.



MOLD DESIGN

The design of this part involved three draws for molding tubes (A, B and C). When gas mask is assembled, tube (A) is fitted with mouthpiece, (B) with flutter valve for exhaling and (C) with ten inch length of hose connected to a canister containing chemicals. This angle tube is molded in a single cavity injection mold.

MOLDING MATERIAL

Tenite II, a cellulose acetate butyrate, is particularly adaptable for molding parts requiring a low moisture absorption, high impact strength and comparatively thin wall sections. In this part the inner wall at point (D) tapers off to a sharp edge inside the tube. The tube is ejected from the mold with a natural, smooth, hard finish and requires no finishing operation. The plasticity of cellulose acetate butyrate can be varied to the degree best suited to the molding method employed and to the physical requirements of the article to be molded, thus speeding and simplifying the molding process.

Send for additional file card of Aico's plastics applications.

AICO

Aico PRECISION MOLDING

29th Year

AMERICAN INSULATOR CORPORATION, New Freedom, Pa.

Sales Offices: BOSTON · BRIDGEPORT · BUFFALO
CLEVELAND · DETROIT · NEW YORK · PHILADELPHIA

HOW *your company*

CAN CONTROL THE OUT-PUT OF THREE MOLDING PLANTS

The answer is simple: by hiring us as your custom molder.

If you are looking for an additional source of supply of an established molded item, our molding departments in three separate plants (New Jersey, Vermont, Canada) can help you.

If your problem is a new application of plastics, or a re-engineering of some existing job—again, our set-up can handle the job.

Our facilities are extensive enough to serve the requirements of the largest industries. Conversely, each separate plant can serve smaller, localized industry with great economy. Mack Molding Company, Wayne, New Jersey; Arlington, Vermont; Waterloo, P. Q., Canada.

Mack MOLDED EXCELLENCE

Pluviometry* Turns to Plastics

DETACHABLE TOP
WHEN RAINFALL EXCEEDS 1" OVERFLOW DRAINS FROM OUTLETS INTO OUTER CONTAINER. EXCESS IS MEASURED BY POURING INTO CENTER TUBE
FUNNELLED BOTTOM CARRIES RAINFALL INTO CALIBRATED CENTER TUBE

IRVINGTON, N. J.—The Army Signal Corps, working in close collaboration with the Dillon-Beck Mfg. Co., has developed a plastic rain gage based on an entirely new principle. Supplanting the time-honored method of dipping a measuring stick into an open container, this new gage gives the accuracy required and readings up to 1" are shown at a glance.

The gage consists of five interchangeable sections, the molding of which is held within a tolerance of 1% so that exact fit is obtained. It is designed to serve in any climate and retain its dimensional stability.

"The development of this gage is particularly important," explains an officer of the concern, "because of the part weather plays in planning and fighting a war. One example of this is the fact that amount of rainfall is always taken into careful consideration before sites for air fields are selected."

The rain gage, produced in its entirety at the Dillon-Beck plant, has now been adopted in several branches of the service.

*Science of measuring rainfall.

DILLON-BECK MANUFACTURING COMPANY
IRVINGTON, N. J.
ENGINEERS · DESIGNERS · MOLDERS

WE build molds for all plastics

More than 20 years of successful experience as toolmaker to leading custom and proprietary molders qualify us as your mold designer and mold maker on your most exacting jobs of plastics engineering.

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MOLDS FOR PLASTICS
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Employees *can't* misunderstand—when they have *photo-exact* copies of letters, orders, blueprints, technical data or sketches. A dozen departments or branch offices can have A-PE-CO photo-copies on file! You can copy practically everything — even blueprints of which no tracings are on hand. Any office boy or girl can make A-PE-CO photo-copies quickly and easily. No technical knowledge necessary. Thousands of America's largest business houses have found the A-PE-CO Photo-Copyer indispensable. See how *you* can use it to avoid mistakes and save time.

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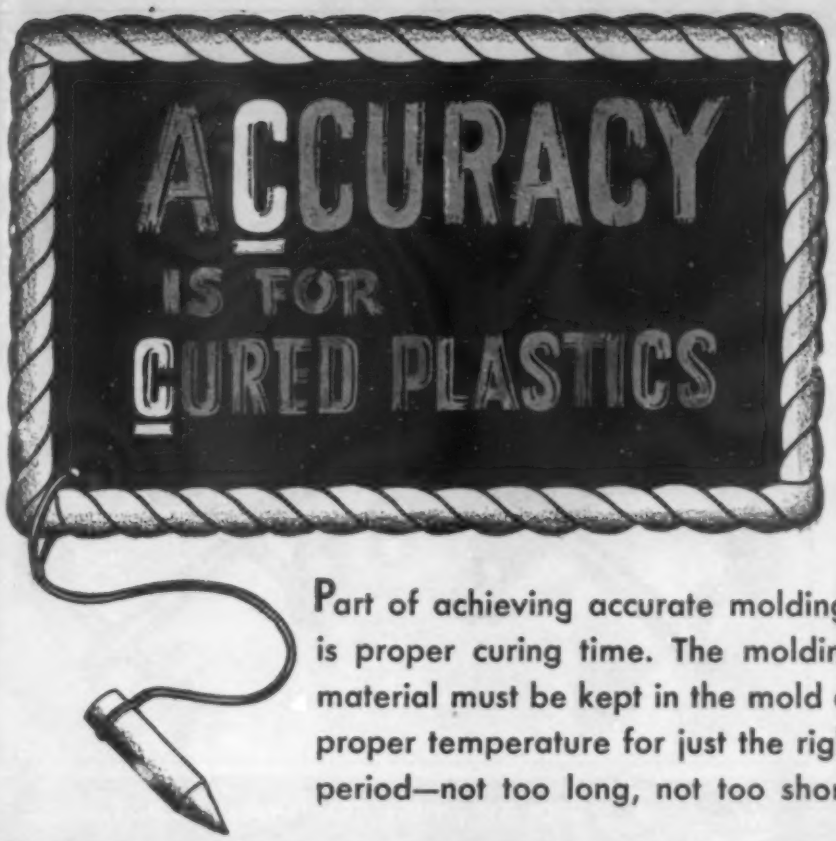
Representatives in Principal Cities — In Canada: Railway & Power Engineering Corp., Ltd.



Part of achieving accurate moldings is proper curing time. The molding material must be kept in the mold at proper temperature for just the right period—not too long, not too short.

ACCURATE moldings are properly cured to insure meeting tolerances — and staying within pre-defined size limits. Proper curing also eliminates internal flaws which might later arise in improperly cured pieces.

This company specializes in moldings as ACCURATE as our name. Consult our engineers on war and postwar production.

ACCURATE MOLDING CORPORATION
116 NASSAU STREET • BROOKLYN, NEW YORK

When You Start To Court New Customers—

Remember

HIGH GRADE PLASTIC MOLDING

Can be a big help!

Two million electric irons have been authorized for production in 1944. Two million irons may be a small item in the total economy, but it shows the trend. Far-sighted manufacturers will be considering the use of plastics who have never thought of it before. Now is the time for you to write to KUHN & JACOB for ways of lowering costs and obtaining more attractive design for that item in which you are interested. Our long experience is a factor that can be invaluable to you.

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Plastic Molding

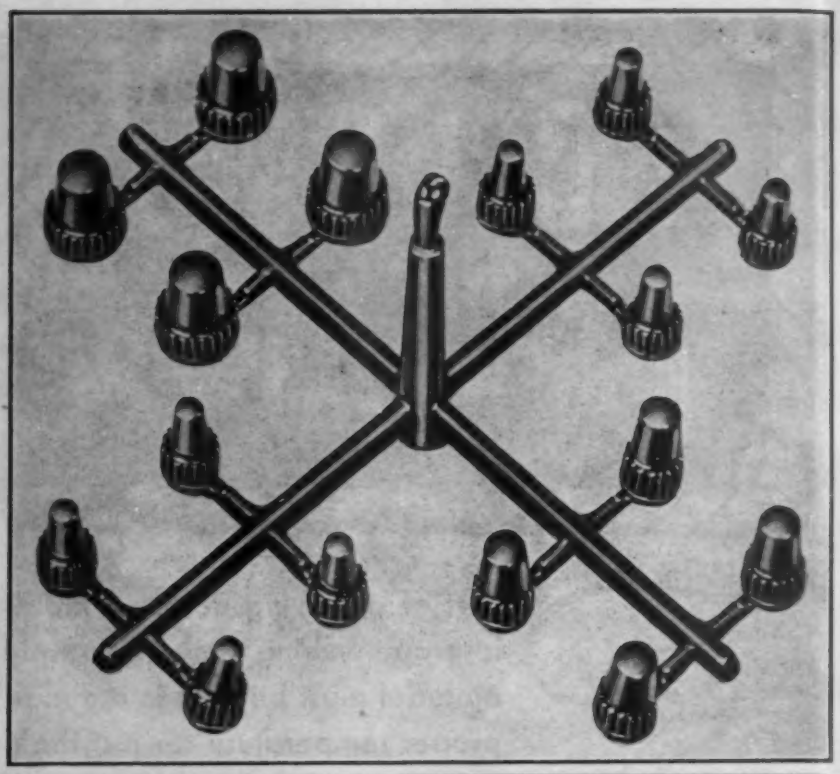
Look Into Your Needs for Tomorrow

— AND DISCUSS IT WITH US TODAY!

While the spotlight today is focused on essential war and civilian needs, the wise, far-sighted industrial leaders are doing their thinking for tomorrow — now!

Ideal, with its vast production facilities in injection molding can help you prepare for peace-time production. Some of the leading plastic men in the field are available to discuss your problems. Their extensive plastic experience is at your disposal.

INJECTION AND EXTRUSION MOLDING



Ideal A SYMBOL OF FINEST CRAFTSMANSHIP IN PLASTICS

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ARMY E NAVY

HIDEN*

(HIGH DENSITY WOOD.)

For eighteen months our total production on HIDEN has been completely absorbed in the War Effort. During this time we have produced and shipped one million pounds of material.

We have recently increased our facilities and personnel. We are now in a position to give engineering service and make recommendations for the use of HIDEN in solving your problems.

PARKWOOD CORPORATION

WAKFIELD, MASSACHUSETTS

*HIDEN (Compreg) Trade Mark

Plastic

Molded Parts WILL MAKE POSSIBLE Better Living FOR EVERYBODY

Yes, plastic molded parts will be much in evidence in the future. War years have accelerated the growth of the plastic industry, immensely. If you are a manufacturer now using plastic molded parts or if there is some application in your present (or projected) production in which they might fit - - - get in touch with Franklin. We'll be glad to talk things over with you.

ARMY E NAVY

Franklin

FRANKLIN PLASTICS DIVISION
Robinson Industries Inc., -- FRANKLIN, PA.

Speed King of Assembling

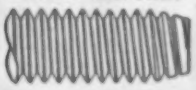
Slotted or Recessed Heads

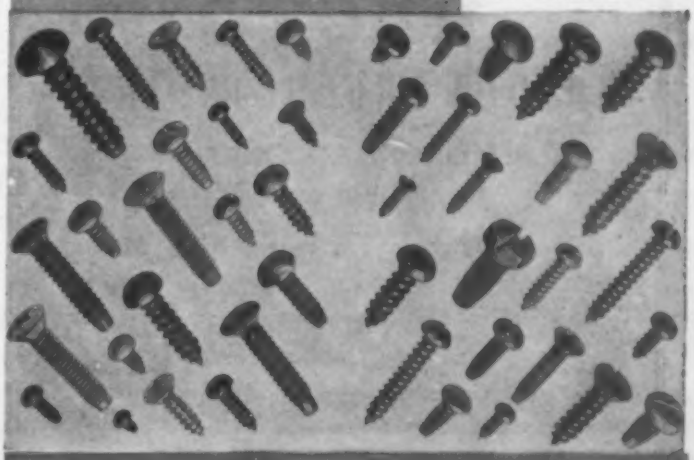
HOLTITE "Thread Forming" SCREWS

If you are looking for speed-up methods in your assembling, eliminate time-consuming tapping operations by using HOLTITE "Thread-Forming" screws for metal-to-metal and plastic fastenings. Cutting their own threads in drilled, pierced or formed holes, these speed screws effect a stronger, tighter, vibration-resisting fastening as each thread stays tight in the perfect mating thread it has cut in the material.

Furnished in three types—Type "A", "Z" and "C." Send for information of specific uses and methods. Check your assemblies—you'll find these speed screws can be used to save time and strengthen many parts of your products.

Also furnished with Machine Screw threads





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STANDARD MOLD BASES FOR
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MOLDING

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The Ideal, Heavy Duty scrap grinder can help you speed vital production. Extra heavy castings and 7 extra-thick, solid tool-steel knives enable this machine to take heavy pieces of scrap and quickly regrind it into usable molding powder of any desired granulation. 3 screens supplied with each machine. Other features: Texrope drive, outboard sealed SKF bearings, 5 hp. ball-bearing motor.

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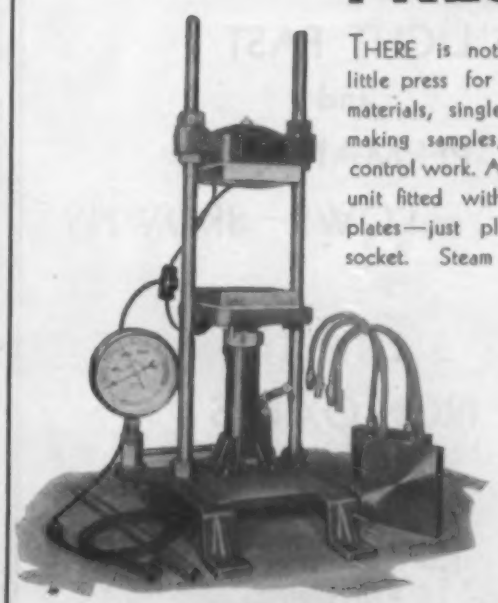

THERE is nothing like this little press for testing plastic materials, single cavity molds, making samples, research and control work. A self-contained unit fitted with electric hot plates—just plug into light socket. Steam hot plates if desired.

- Write for catalog giving full details.

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FIFTY YEARS *is a long time in plastics*

If we told you that we had been fabricating steel or wood for fifty years you might suspect us of being a Johnny-Come-Lately who was trying to build himself up.

But in plastics, fifty years is almost the life-span of the industry. It takes you back to when shellac and celluloid were the only plastics used. It carries you through a progression of new materials and new methods; a wealth of experience in molding difficult materials that cannot be bought or otherwise acquired.

Our fifty years of plastics "know-how" are at your service.

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CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY
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Numerous Plastics Plants are now using This remarkable valve.

They are using it for reducing pressures as high as 6,000 lb. per sq. in. which it does capably WITHOUT SHOCK. Whether the medium is water, oil, or air, makes no difference to this valve.

If you want complete information, it is known as the

ATLAS Type "E"
High Pressure Reducing Valve

Why Is It So Good?

Because it is made by a concern that specializes in regulating valves exclusively. It is modern in every respect. It is founded on the latest design and research. Forged Steel Body. Internal metal parts entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

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Representatives in principal Cities

TODAY

Perhaps you are using tubular rivets now in one of your fastening operations.

Often, where riveting operations are involved customers pass their problems on to us, and from such accumulated experience we are often able to supply the missing answer.

Whether you now use MILFORD tubular rivets or those made by some other manufacturer is immaterial—if we, as rivet specialists can help speed deliveries of materiel, we want to help. Will you accept our offer in the spirit of the "American way"?

TOMORROW

As the war draws nearer to its close, more and more manufacturers are dusting off the blueprints of that "post-war product," looking to the day when the signal will be given to resume making civilian goods.

Some of these products require fastening operations. Don't overlook the advantages of tubular rivets when your fabricating plans are under discussion. Permanency—Low cost—Speed of application—Availability of supply—these are a few of the advantages of tubular rivets which may serve to give you the edge on competing products. We would like to think ahead with you now instead of waiting for the zero hour.

Present mass production for war needs still leaves our rivet engineers with time to interest themselves in your fastening requirements.

The MILFORD RIVET & MACHINE CO.

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FOR ELECTRICAL AND GENERAL PURPOSES

Precise, Clean, and Sharp... these panels represent the natural results of engineered fabricating. LF technicians are qualified by specialized experience... they know how to plan and produce in meeting exacting fabricating requirements.

This engineering procedure for precision fabricated parts may suggest new methods for simplifying your production. Your inquiries will receive cooperative responses...promptly.

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FINE electric furnace steels. Disston Plastiron and Plastalloy are made to fine tool standards and are *ideal* materials for plastic molds. They have a low carbon content—excellent for difficult shapes—are thoroughly clean and uniformly sound—produce unusually smooth cavities—carburize evenly—and will withstand extreme hobbing.

Engineering Cooperation... Disston metallurgists and engineers will gladly cooperate in adapting Plastiron to your present methods—and will help you with postwar planning. Write fully to Henry Disston & Sons, Inc., 334 Tacony, Philadelphia 35, Pa., U. S. A.

FROM KITCHEN TO FACTORY

The plastic molder is faced with a three-fold problem . . . help that never before worked in a factory . . . new powders . . . and requirements for finished plastics more exacting than ever before. To overcome these difficulties Powder Manufacturers recommend the regular use of the CAMBRIDGE Mold Pyrometer. It is so simple to use, inexperienced help can use it effectively.

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It is accurate, quick-acting and sturdy.

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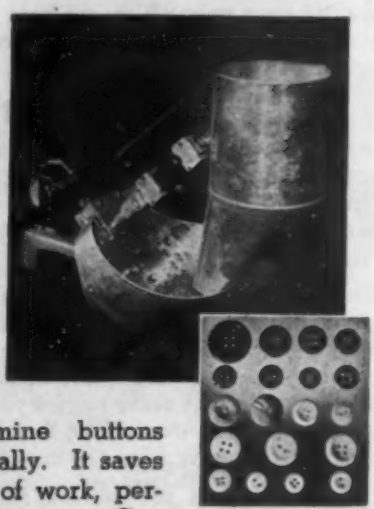
Bulletin 194—S gives details of these instruments. They help save money and make better plastics.

Automatic Button Finisher

SAVES MANPOWER



THIS compact automatic machine punches fins and cleans holes of Urea, Phenol and Melamine buttons completely automatically. It saves countless man-hours of work, performs with perfect efficiency. Can be set & re-set to handle all sizes. 3 models: Model S accepts sizes 12 to 34; Moden SP accepts sizes 36 to 50; Model SX accepts sizes 12 to 50. Production up to 450 per minute.

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Years of experience at IMP in pre-war and war work assure jobs done right. IMP designers, engineers, tool and die makers, and molders are ready to serve in the BIG JOBS ahead. Let our craftsmen engineer your next job. In planning for tomorrow contact us today.

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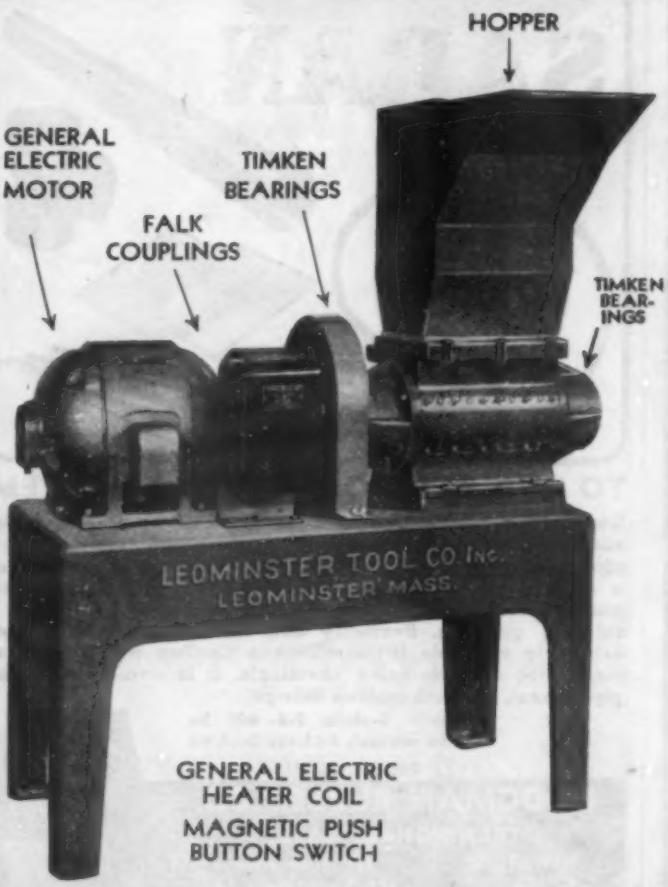

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These plastic granulating machines have been developed to give the plastics industry a sturdy, economical piece of equipment. Each comes equipped with one screen, ¼" or ⅛" mesh, which can be interchanged in 2 minutes. Hopper swings back for easy cleaning. Granulated material is delivered through end chute.

Best grade of alloy steel is used for blades and cutter. Spindle is made of high tensile strength alloy steel, hardened and ground. Timken roller bearings assure long life, trouble-free operation.

2 MODELS

Model #1		Model #2
3 H. P.	Motor -	5 H. P.
100-lbs. per hour		200 to 400
46" x 18"		Floor space - 68" x 24"
680 lbs.		Weight 870

MANUFACTURER OF

INJECTION MOLDING MACHINES AND MOLDS

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LEOMINSTER, MASS.

JOEY-ON-THE-JOB SAYS . . .
"PLASTICS! I've been meeting their 'hot' handling jobs . . . and I always give JOMAC a big hand!"

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Heat-Resisting Gloves

Protective gloves specially designed for workers in PLASTICS

The remarkable Jomac Fabric is helping to lick the many hot and heavy jobs in America's busy plastics plants. "Cushion" loops protect the hands and allow constant handling of materials too warm to touch. Durable, extra-long wearing . . . and they can be laundered repeatedly, *kept clean* . . . a safeguard against skin infections.

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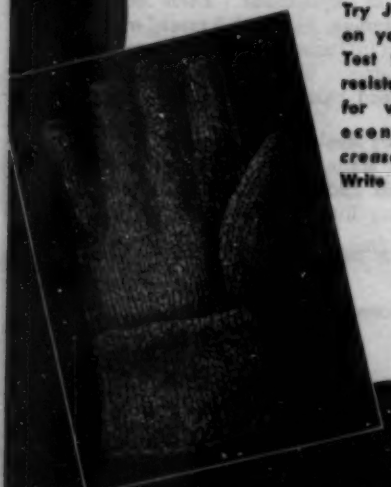
Try JOMAC GLOVES on your stiffest jobs. Test them for heat-resistance, for wear, for washability, for economy, for *increased production.* Write for full details.



JOMAC INDUSTRIAL WORK GLOVES
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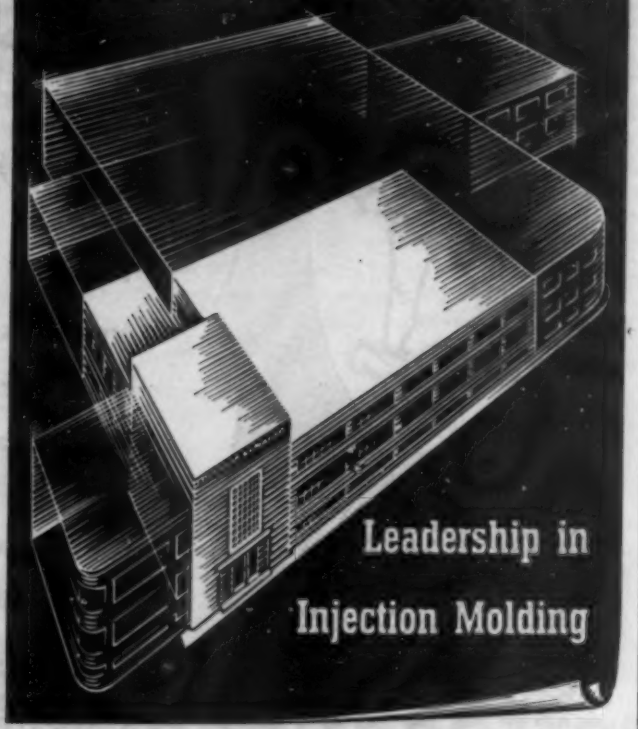
TODAY AND TOMORROW...



Leadership in Injection Molding

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SARAN

TO END ALL CORROSION PROBLEMS

Saran is a tough thermoplastic originally made to replace such strategic war materials as aluminum, stainless steel, nickel, copper, brass, tin and rubber. Now found adaptable to a wide range of uses in product designing, food processing and wherever non-corrosive materials are necessary. Its insulating qualities, flexibility and ease of handling make it extremely valuable in installations dealing with oils, gases, air, water and corrosive chemicals. It is available in tube, pipe, sheet, rod and molded fittings.

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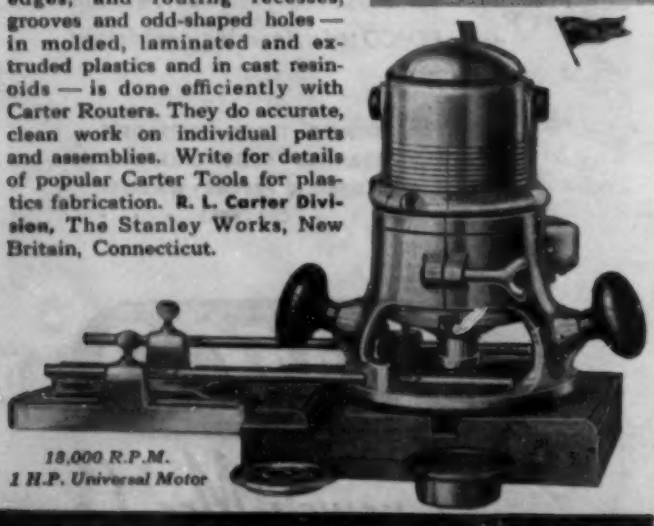

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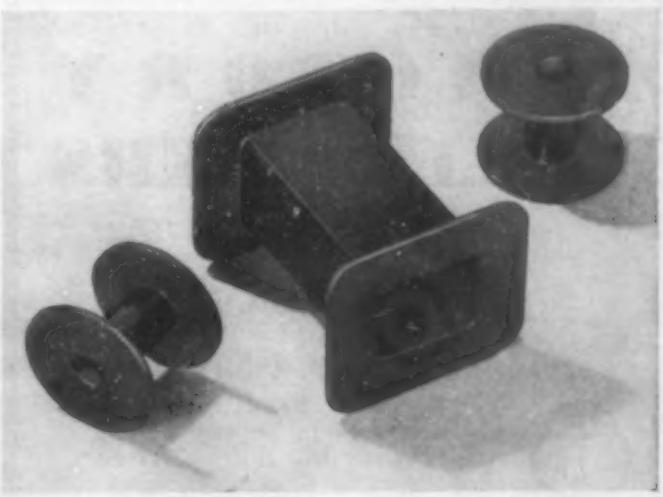

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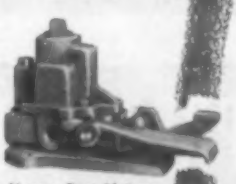
This model "Unitite" valve is for manifold mounting.



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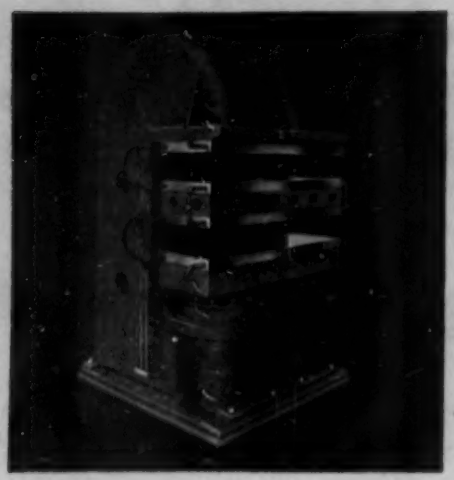

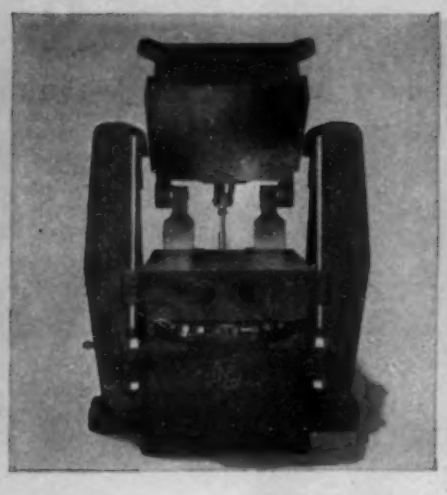

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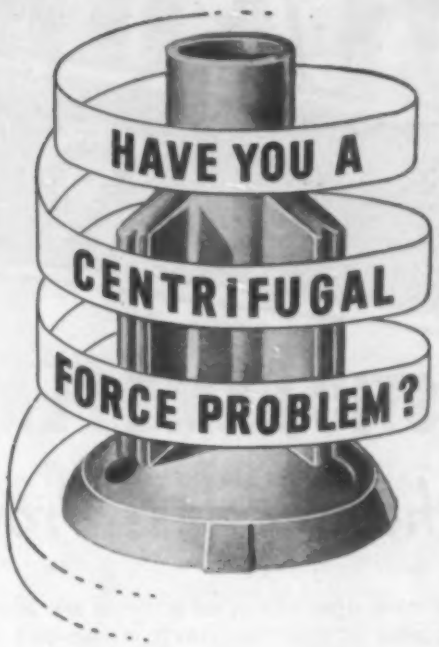

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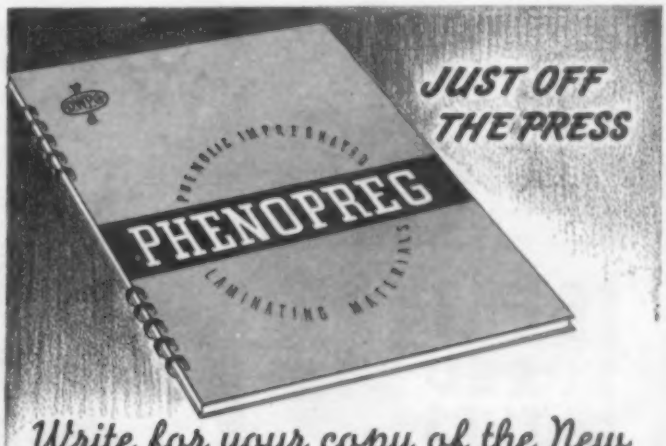

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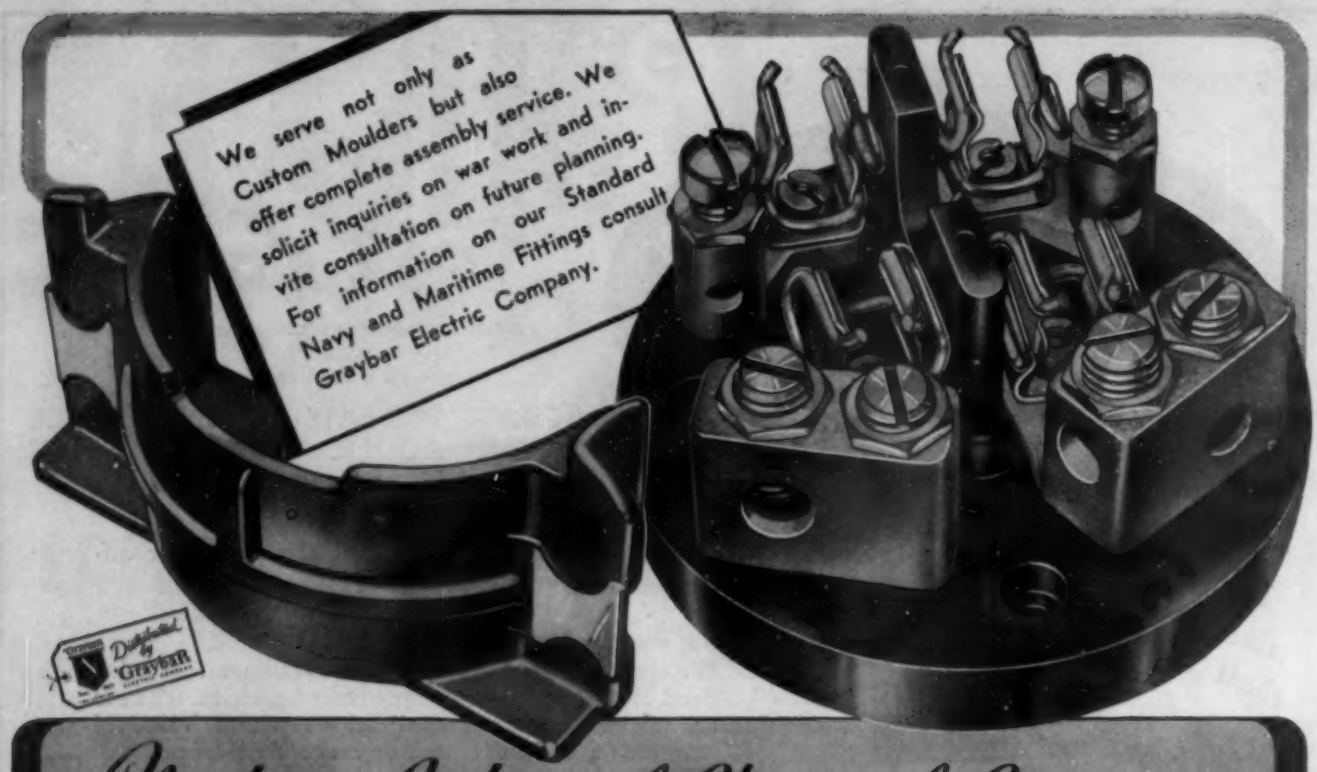
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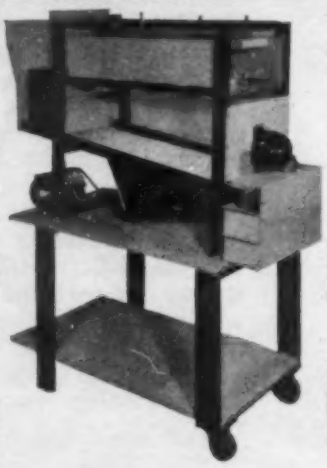

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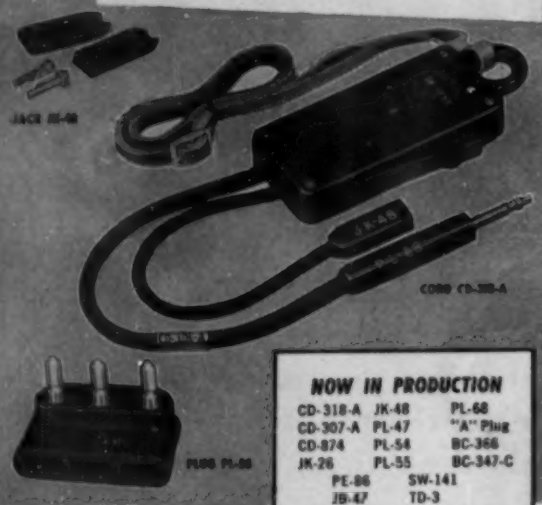

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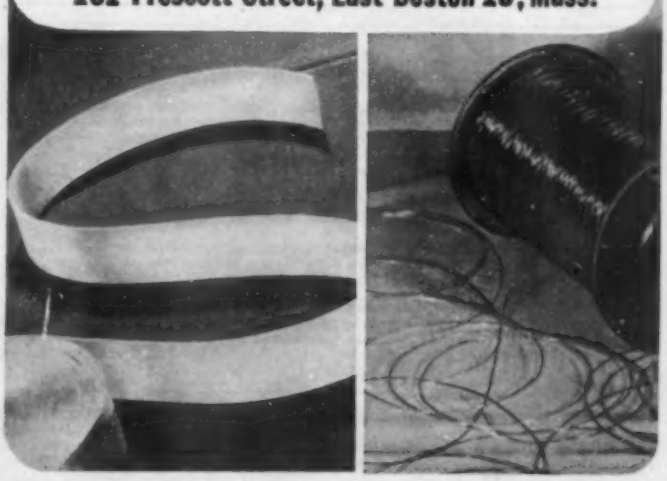

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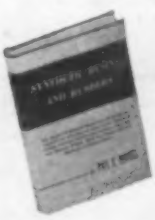

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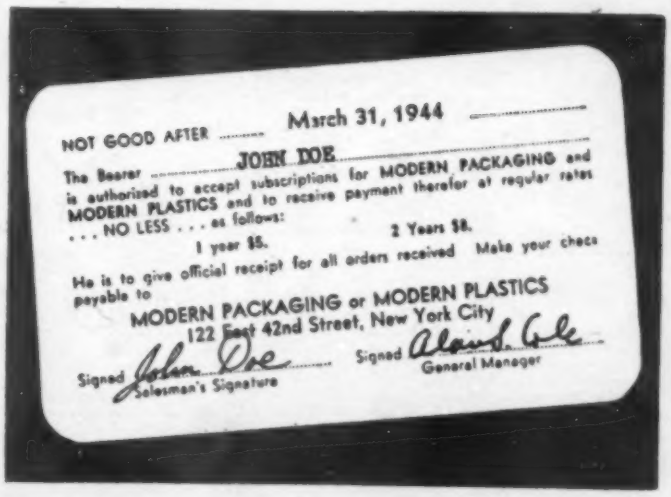
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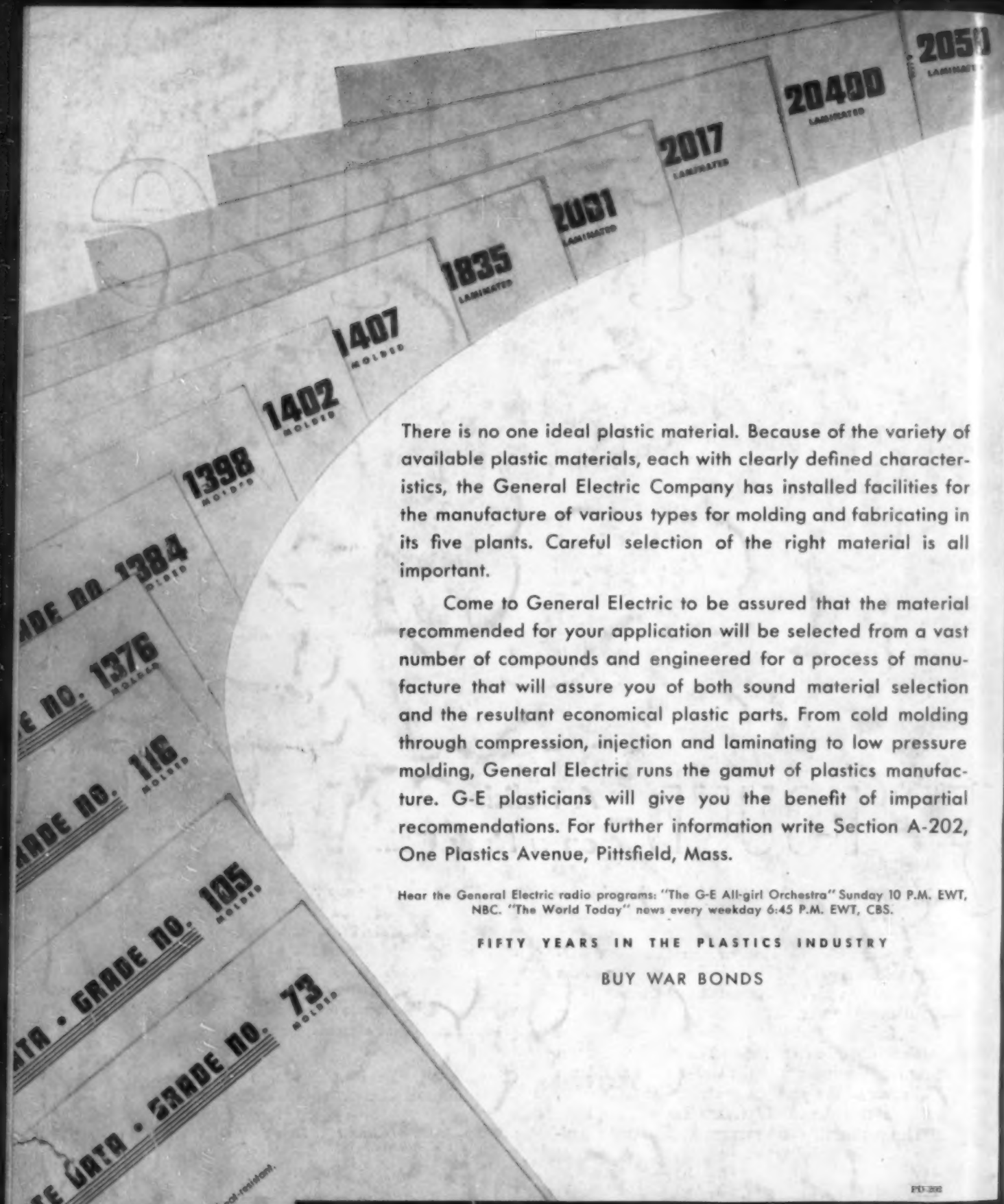

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